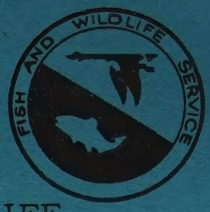
RIODICAL
6(1)
6(1)
LIBRARY
OCT 2 1961
FISH & WILDLIFE SERVICE

Sport Fishery Abstracts

Vol. 6 No. 1
Abstracts 3814 - 4026
January 1961

DEPARTMENT OF THE INTERIOR

Stewart L. Udall, *Secretary*



U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

Daniel H. Janzen, *Director*

The printing of this publication

was approved by the Director of

the Bureau of the Budget

January 4, 1961

Washington 25, D. C.

Sport Fishery Abstracts

An abstracting service for fishery research and management

Vol. 6 No. 1 Abstracts 3814-4026 January 1961

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of papers on limnology, ecology, natural history and other fields of specialization will be included when the subject has application to the conservation of sport fish and the restoration of sport fishing.

One volume consisting of not more than four numbers will be issued each year. Each number contains separate Author and Subject indexes, with the final number of each volume containing cumulative indexes.

The last number of each volume contains a list of publications screened for appropriate material. Suggestions for improving the usefulness and coverage of Sport Fishery Abstracts are solicited.

The Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U. S. Fish and Wildlife Service. Requests for other articles should be sent to the author or publisher.

Prepared in the Branch of Federal Aid
S. E. Jorgensen, Chief
Donald F. LaPointe, Editor
Geneva T. Thompson, Asst. Editor

3814. Anonymous. 1960. SYMPOSIUM ON FISH BEHAVIOUR. Proceedings, Indo-Pacific Fisheries Council, 1958, F. A. O. 116 pgs.

With regard to fish-searching and fishing, it is shown that the presence of fish of a particular species in particular places at particular times is itself an expression of behaviour largely determined by the internal drives of the organism and by its reactions to environmental conditions and to particular environmental directives.

In this field also the activity of fish on fishing grounds, and their reactions to various natural and artificial elements of the environment are taken into account in design and operation of fishing gear.

With regard to management of fisheries it is obvious that in many respects the magnitude and composition of fish populations is influenced by factors that can modify or interfere with patterns of behaviour. It is not so clear however, in the present state of our knowledge of dynamics of fish populations, considering the assumptions that must be made and the order of accuracy within which calculations are made, that improved knowledge of fish behaviour could lead to a refinement of the results obtained in this field. On the other hand, it is unquestionable that a study of the general biology of any species that neglected behaviour would lack conclusions on many matters. A point that needs to be made here is that although laborious work to measure differentials of behaviour, resulting from fluctuations in determinants, might not be justifiable considering the small improvements such work could bring to equations in population dynamics, qualitative work to ascertain the general features of the behaviour of a species is indispensible to the basic account of its biology.

Behaviour studies can give guidance on action to be taken when spawning migrations are threatened, or actually barred by dams and other constructions; similarly, if spawning sites are spoiled by pollution, or if a species will not reproduce under the conditions offered in ponds, behaviour research may show how remedial or developmental action may be taken.

Behaviour research, like other lines of scientific enquiry, can be carried out in various ways. Its programme can be made exceedingly complex and can be extended far into physiological, anatomical and other means of studying the bases to behaviour. (From auth. concl.)

3815. Anonymous. 1960. TOXIC EFFECTS OF ORGANIC AND INORGANIC POLLUTANTS ON YOUNG SALMON AND TROUT. State of Washington, Department of Fisheries, Research Bulletin No. 5, 264 pgs.

Pulp mill wastes are a major source of industrial pollution. The results of the studies on the effects of sulfite waste liquor on salmon were published in 1953. Since then studies have been made of the effects of other pulp mill wastes as well as other industrial effluents and their components.

Because of the wide variety of pollutants tested, they have been grouped into two principal types. Organic wastes contain carbon compounds and are generally oxidizable so that they reduce the oxygen content of the water. The volume of inorganic wastes discharged in this state is smaller than that of organic wastes, but comparable amounts are generally more toxic to fish.

Because the effects of some of the pollutants varies according to the type of medium, species and length of fish, and period for which the fish were exposed, these variables are also included in the resume. Since an exposure of three days was generally used as a standard period for comparison of the effects of different pollutants, the results obtained at the end of three days in the longer experiments are also recorded.

Fish kills in the waters of this state due to such pollutants can easily escape notice, since virtually all of the mortalities in these experiments sank to the bottom of the aquaria after loss of equilibrium.

3816. Holt, Romona Denton. 1960. COMPARATIVE MORPHOMETRY OF THE MOUNTAIN WHITEFISH, PROSOPIUM WILLIAMSONI. Copeia, No. 3, pp. 192-200.

Whitefish were obtained from three major drainages as follows: (1) Tongue River, (2) South Fork of Shoshone River, (3) Yellowstone River, (4) Hebgen Lake, and (5) Red Rock Creek; Columbia River drainage, (6) Bitterroot River, (7) Whitefish River, (8) Thompson Lakes, (9) Lake Pend Oreille, (10) Phelps Lake, and (11) McKenzie River; Bear River drainage, and (12) Logan River.

Measurements and counts were taken on all 357 fish. The means of body ratios and meristic characters were tested by analysis of variance in seven different combinations.

The majority of the tests were significant at the 1 percent level. The ranges of variation for most body proportions and counts overlapped, but some means differed greatly among collections and drainages.

Collections from McKenzie River were not distinguishable among all collections.

Body proportions and meristic characters from 12 studies of 6 coregonine fishes (P. williamsoni, P. oregonium, P. spilonotus, P. coulteri, P. cylindraceum, and C. clupeaformis) were distinguishable from one another. The body proportion and count ranges of P. oregonium fell within the ranges of P. williamsoni. (Auth. summ.)

3817. Parry, Gwyneth. 1960. THE DEVELOPMENT OF SALINITY TOLERANCE IN THE SALMON, SALMO SALAR (L.) AND SOME RELATED SPECIES. The Journal of Experimental Biology, Vol. 37, No. 2, pp. 425-434.

A study has been made of the survival and osmotic regulation of young salmonid fishes following transfer from fresh water to various dilutions of sea water.

Survival is in the order:

Salmo salar > S. gairdnerii > S. trutta

and is generally better the larger the fish. The survival pattern of alevins differs from that of the older stages. Hypo-osmotic regulation is first seen in parr and becomes fully effective in smolts. (Auth. summ.)

3818. Murray, R. W. 1960. THE RESPONSE OF THE AMPULLAE OF LORENZINI OF ELASMOBRANCHS TO MECHANICAL STIMULATION. The Journal of Experimental Biology, Vol. 37, No. 2, pp. 417-424.

The ampullae of Lorenzini are sensitive to weak tactile stimulation applied to the ends of their jelly-filled tubes. Either an increase or a decrease in their resting discharge frequency may be caused, each with an opposite after-effect. 'Adaptation' is total, being three-quarters completed in 3-8 sec. This 'adaptation' probably includes accommodative changes of the tissues. The function of the ampullae is discussed, but no definite conclusion can yet be reached. (Auth. summ.)

3819. Noble, Elmer R. 1960. FISHES AND THEIR PARASITE-MIX AS OBJECTS FOR ECOLOGICAL STUDIES. Ecology, Vol. 41, No. 3, pp. 593-596.

A study of parasites with their hosts is a study in ecology because each member of the associating pair is part of the environment of the other member. The parasite mix is the total parasite fauna and flora of any plant or animal. The parasite-mix of fish gills has been described, and mention made of the kinds of parasites, which may be encountered in other organs of fishes. In host organs burdened with a number of parasites a ferment of activity is continuously taking place involving competition for space and food, and the production of enzymes which affect profoundly both host and parasites. The kinds of food surrounding fishes are of prime importance in the problem of maintaining adult parasites, and the influences of seasonal changes in temperature and light serve to alter markedly the parasite-mix of fish hosts. The older the fish the more parasites it normally has, but migratory fishes often change the nature of their parasites as they move from one habitat to another. The process of acclimatization to a new environment usually leads to impoverishment of the fish's parasites. Although fish parasites may be gained or lost during environmental changes, some of them are host-specific (e.g., monogenetic trematodes), but most of them are able to live and to develop normally in two or more species of hosts. The use of parasites as ecological labels provide an abundance of information about the habits and habitats of their hosts. (Auth. summ.)

3820. Davis, John H. 1960. PROPOSALS CONCERNING THE CONCEPT OF HABITAT AND A CLASSIFICATION OF TYPES. Ecology, Vol. 41, No. 3, pp. 537-541.

A brief review of the term habitat and the confusion of habitat with environment and other terms and concepts is followed by a discussion of the broad concept of habitat. In this discussion, it is emphasized that habitats may be either occupied or unoccupied by living organisms, that they have the resources needed for the particular life considered, and that these resources are made available to the organism through the agency of the operational environment at levels above the minimum requirements for the living processes of that organism. In considering the attributes and implications of the concept of habitat, the relative constancy and inconstancy of the essential conditions is stressed and these are selected as the basis for the primary types of habitats in a classification of habitats that is proposed. An outline of these types and the subtypes of each is presented. (Auth. summ.)

3821. Pearson, Oliver P. 1960. A MECHANICAL MODEL FOR THE STUDY OF POPULATION DYNAMICS. Ecology, Vol. 41, No. 3, pp. 494-508.

A mechanical model is described that is capable of handling numerous variables such as litter sizes of different age groups, sex ratio, density independent mortalities of different age groups, proportional mortalities of different age groups, compensatory alteration of the breeding rate. These variables can be changed singly or in combination to demonstrate what the effect will be on the size of the population at equilibrium, the stability of the population and the age structure and sex ratio of the population. (From auth. summ.)

3822. Paterson, R. A. 1960. INFESTATION OF CHYTRIDIACEOUS FUNGI ON PHYTOPLANKTON IN RELATION TO CERTAIN ENVIRONMENTAL FACTORS. Ecology, Vol. 41, No. 3, pp. 416-424.

The percentage of parasitism of Anabaena planktonica by Rhizosiphon anabaenae occurred in two maxima during 1955. These maxima took place during the decline of the Anabaena spring and autumn blooms. Results of this investigation, in contrast to those described by Canter and Lund (1948, 1951, 1953) in their work on English lakes, indicate that parasitism does not hasten the algal decline. Rather, there are strong indications that decline in Anabaena cells is caused by environmental physical-chemical factors, not by parasitism. The senility of the declining population due to these causes is more likely to permit parasitism than for the parasite to initiate or hasten the decline of the algal population. (From auth. summ.)

3823. Scrimger, J. A. 1960. TEMPERATURE VARIATIONS IN ESQUIMALT LAGOON - A SMALL LANDLOCKED BODY OF WATER SUBJECT TO TIDAL FLUSHING. Limnology and Oceanography, Vol. 5, No. 4, pp. 414-424.

Time series observations, extending over two tidal cycles, of temperatures and micro-temperature fluctuations at different positions and surface wave amplitudes at two fixed locations have been obtained in Esquimalt Lagoon (Esquimalt, B. C., Canada). The Lagoon is coupled to the sea by a narrow channel which permits about one-third of the low tide water to be exchanged during a tidal cycle. A technique using drags and aerial photographs has

enabled the water circulation to be measured. Temperatures measured two inches from the bottom exhibit remarkable stability (< 0.1°C fluctuation). No correlation between vertical temperature structure and surface waves or between micro-temperature fluctuations and surface waves is observed. (Auth. abst.)

3824. Bryson, Reid A., and Robert A. Ragotzkie. 1960. ON INTERNAL WAVES IN LAKES. Limnology and Oceanography, Vol. 5, No. 4, pp. 397-408.

The dominant feature of short period thermal unrest in a stratified lake is the periodic nature of the temperature variation. When such variations at a point occur within a few minutes, periodic vertical motions of the water are implied, for other heat transfer mechanisms within the lake are too slow. These periodic motions, internal waves, may be studied at a given depth by simultaneous continuous temperature measurement at three closely spaced stations. From these observations and the mean vertical gradient the amplitude, direction, period, and speed of the internal waves have been determined.

Long, standing internal waves have been described often in the literature as seen through temperature observations. They may also be studied by means of their "surface reflection." (Auth. abst.)

3825. Verduin, Jacob. 1960. PHYTOPLANKTON COMMUNITIES OF WESTERN LAKE ERIE AND THE CO_2 AND O_2 CHANGES ASSOCIATED WITH THEM. Limnology and Oceanography, Vol. 5, No. 4, pp. 372-380.

Phytoplankton studies using samples concentrated by settling revealed population densities several times higher than those reported previously, based on centrifuge and bolting cloth concentrates. Clear and dark bottle experiments employing natural population densities revealed photosynthetic yields averaging 1.6 µmoles of CO_2 absorbed per microliter of plant volume per hour. This yield is three times higher than previously reported yields based on artificially concentrated populations. Comparison of daily photosynthetic yields per square meter of water as computed from bottle data with yields measured under completely natural conditions indicated an additional twofold discrepancy, with the natural condition yielding the higher value. The reduction of turbulence in bottles may be operating to reduce the photosynthetic yield. Eddy diffusivity in western Lake Erie, computed from pH change in the dysphotic zone, and vertical pH gradients, is about 25 cm^2/sec. Simultaneous determinations of CO_2 and O_2 changes showed that O_2 changes usually were lower than CO_2 changes, suggesting that processes other than photosynthesis are influencing the CO_2 and O_2 budgets. (Auth. abst.)

3826. Wright, John C. 1960. THE LIMNOLOGY OF CANYON FERRY RESERVOIR: III. SOME OBSERVATIONS ON THE DENSITY DEPENDENCE OF PHOTOSYNTHESIS AND ITS CAUSE. Limnology and Oceanography, Vol. 5, No. 4, pp. 356-361.

A series of 24-hr determinations of net photsynthesis confirmed the conclusions derived from previous 6-hr experiments that the relationship between photosynthesis and standing crop is not linear. The optimal rate of net photosynthesis per unit chlorophyll varied inversely with chlorophyll concentration. As a result net euphotic zone photosynthesis was maximal at intermediate values of chlorophyll concentration and was less at chlorophyll concentrations above or below the intermediate range. From previously derived relationships between chlorophyll, gross photosynthesis, and respiration, values of net euphotic zone photosynthesis were computed for each chlorophyll concentration. The computed values agreed well with the observed values. The decline of CO_2 concentration as standing crop increased was suggested as the most probable cause of the observed photosynthesis standing crop relationship. (Auth. abst.)

3827. Craig, R. E., and R. Priestley. 1960. PHOTOGRAPHIC STUDIES ON FISH POPULATIONS. Nature, Vol. 188, No. 4747, Oct. 22, 1960, pp. 333-4.

Electronic flash cameras are suspended from a stationary or drifting research vessel, and operated either from the ship or by triggering at a set distance from the bottom. The cameras, using dry batteries and operated by a clockwork timer, can take about 200 exposures at pre-set intervals and have been used in two ways:

1. Attached to photograph the trawl groundrope and immediate zone - this confirmed frogmen's observations that fish are aware of the gear and swim away from groundrope.
2. Left on sea bed for subsequent recovery. On herring - showed that numbers and shoaling pattern did not vary with time of day or night and that fish were present in small shoals of 12-20 fish. Population was estimated from known lens angle and limits of visibility.

3828. Broadhead, Gordon C., and Craig J. Orange. 1960. SPECIES AND SIZE RELATIONSHIP WITHIN SCHOOLS OF YELLOWFIN AND SKIPJACK TUNA, AS INDICATED BY CATCHES IN THE EASTERN TROPICAL PACIFIC OCEAN. Inter-American Tropical Tuna Commission (Comision Interamericana Del Atun Tropical), Vol. IV, No. 7, pp. 449-492.

The data clearly indicate that the yellowfin and skipjack tuna do school by species, as a large share of the total catch by both types of gear is made from single-species schools, although the geographical distributions of the two species overlap to a large degree. Schooling by size is also demonstrated as the individuals from each school are more like each other than would be expected if they were drawn at random from the entire population. Schooling by size is evidently somewhat modified by the species relationship, as yellowfin tuna from schools of mixed composition are smaller and vary less in length range than the yellowfin from pure schools.

3829. Srivastava, P. N. 1960. INFLUENCE OF THYROID ON RADIOPHOSPHORUS METABOLISM IN FISH. Nature, Vol. 118, No. 4749, Nov. 5, 1960, pp. 512-513.

The results show that thyroid has positive influence over the mineral metabolism in fish, but it cannot be said definitely at present whether this control is direct or is indirect through some intermediate agency.

3830. Alverson, Franklin G. 1960. DISTRIBUTION OF FISHING EFFORT AND RESULTING TUNA CATCHES FROM THE EASTERN TROPICAL PACIFIC BY QUARTERS OF THE YEAR, 1951-1958. Inter-American Tropical Tuna Commission (Comision Interamericana Del Atun Tropical), Vol. 4, No. 6, pp. 321-446.

This is a data report based on information collected from the logbooks of baitboats and purse-seiners engaged in the fishery for yellowfin (Neothunnus macropterus) and skipjack (Katsuwonus pelamis) tuna in the Eastern Tropical Pacific Ocean from 1951 through 1958. The detailed analysis of these data appears in other research bulletins, some already published and others in preparation.

3831. Hansen, Donald F., George W. Bennett, Robert J. Webb, and John M. Lewis. HOOK-AND-LINE CATCH IN FERTILIZED AND UNFERTILIZED PONDS. Ill. Nat. Hist. Surv. Bull. 27(5): 345-390. 1960.

A six-year study of fishing in 3 fertilized and 3 unfertilized farm ponds in Southern Illinois has shown that catch per hour rate for the bluegill, Lepomis macrochirus Rafinesque, was considerably better in one fertilized pond and slightly better in two fertilized ponds than in the controls. Only one of the three fertilized ponds furnished better catch rates for largemouth bass, Micropterus salmoides (Lacepede), than the control ponds. Bluegills caught from the fertilized ponds were of slightly larger average size, bass were of slightly smaller average size than those caught in the control ponds. In the fertilized ponds the bluegill harvest in pounds per acre was 2.4 to 4.0 times the bass harvest; in the control ponds the bluegill harvest was 0.9 to 1.3 times the bass harvest. In a census of the pond populations made at the conclusion of the fishing study -- where all fish were killed with rotenone -- the fertilized ponds contained 255-318 pounds of fish per acre, control ponds 169-308 pounds per acre. Little correlation was found between standing crops or in numbers of harvestable bass and bluegills in the ponds and the relative success with which bass and bluegills had been harvested in the same ponds in earlier years. (Auth. abst.)

3832. Berezina, N. A. 1956. THE USE OF INSECTICIDES TO CONTROL PREDACEOUS INSECTS WHICH ARE ENEMIES OF FISH. Voprosy Ikhtiologii, No. 7, pp. 209-220, 1956. Fisheries Research Board of Canada, Translation Series no. 256, 1960.

Our experiments showed that powder insecticides, DDT and hexachloran, are very toxic not only to air-breathing predaceous insects (Coleoptera and Hemiptera), but also to carp fry, especially in the early stages, when the mortality observed reached up to 80%. DDT and hexachloran are not recommended for use against predaceous insects, enemies of young fish.

The kerosene film is very promising against predaceous insects. Ten ml of kerosene over 1 square metre (1 m^2) makes a film thick enough to kill air-breathing insects quickly: the majority dies 8-10 hours after the application of the kerosene. The kerosene film has no ill effects on carp fry or planktonic invertebrates. (From auth. concl.)

3833. Karzinkin, G. S., E. V. Soldatova, and I. A. Shekhanova. 1959. SOME RESULTS OF MASS MARKING OF "NON-STANDARD" STURGEON FINGERLINGS BY MEANS OF RADIOACTIVE PHOSPHORUS. Migratsii Zhivotnikh (Animal Migrations), No. 1, pp. 27-40, Akademiia Nauk SSSR, 1959. Fisheries Research Board of Canada, Translation Series No. 279, 1960.

In order to mark 100,000 young sturgeon of a weight of 150-200 mg over a period of 3 months, 60-65 millicuries of radioactive phosphorus are needed in the form of the salt $Na_2HP^{32}O_4$. In the process, 1-1.2 kg of flour suspension or 600-700 g hydrolized yeast are consumed, on which 3 kg of oligochaetes are maintained for two days. The marked oligochaetes are consumed by the young sturgeon present in the ponds. After 4 or 5 feedings of oligochaetes all the young fish become uniformly marked.

3834. Gerbilsky, N. L. 1958. THE QUESTION OF THE MIGRATORY IMPULSE IN CONNECTION WITH THE ANALYSIS OF INTRASPECIFIC BIOLOGICAL GROUPS. Akademiia Nauk SSSR, Ikhtiologicheskaia Komissiia, Trudy Soveshchanii, No. 8, pp. 142-152, 1958 (Trudy Soveshchaniia po Fiziologii Ryb.). Fisheries Research Board of Canada, Translation Series, No. 260, 1960.

Attempts to demonstrate an identical nature for the migratory impulse of the anadromous fish of a single species have no foundation.

The development and differentiation of the migratory instinct within a species has a diversifying character, is one of the paths to biological isolation of different spawning populations; and as a species evolves it leads to the production of biological differences among these populations, to biological differentiation which has great importance for the species, and in the final analysis, possibly, also to the development of characteristics that are useful in establishing an infraspecific taxonomy.

3835. Kimsey, J. B., and Leonard O. Fisk. 1960. KEYS TO THE FRESHWATER AND ANADROMOUS FISHES OF CALIFORNIA. California Fish and Game, Vol. 46, No. 4, pp. 453-479.

3836. McFarland, William N. 1960. THE USE OF ANESTHETICS FOR THE HANDLING AND THE TRANSPORT OF FISHES. California Fish and Game,

Vol. 46, No. 4, pp. 407-431.

M.S. 222, tertiary amyl alcohol and methylparafynol are suggested as beneficial for the induction of deep anesthesia (immobility) since they act quickly and recovery is rapid. Recovery from anesthesia is complete, provided that respiratory movements have not ceased for more than a few minutes. No long-term effects of anesthesia were noted in opaleye and the wooly sculpin, nor did repeated inductions of deep anesthesia have any effect on opaleye. Of several anesthetics tested, tertiary amyl alcohol at approximately 2.0 ml. / gallon of water, methylparafynol at 1.5-2.0 ml. / gallon and chloral hydrate at 3.0-3.5 grams / gallon are considered the most desirable anesthetics for transporting both marine and fresh water fishes. For maximum success, fishes should be pretreated for at least 10 to 15 minutes and preferably for one hour in anesthetic. If all fishes are metabolizing at maximum rates, the loads of fishes that can be transported (provided that the temperature is not reduced) theoretically cannot exceed four to five times the normal loads of a given transport unit. Because of mechanical factors and the fact that fishes do not necessarily metabolize at maximum rates during transport the use of anesthetics will probably allow no more than a doubling or an occasional tripling of normal loads. (From auth. summ.)

3837. Greenwood, P. H. 1960. A REVISION OF THE LAKE VICTORIA HAPLOCHROMIS SPECIES (PISCES, CICHLIDAE). PART IV. Bulletin of The British Museum (Natural History), Zoology, Vol. 6, No. 4, pp. 229-281.

Eleven species are redescribed on the basis of new material. In addition, three new species (Haplochromis theliodon; H. empodisma and H. saxicola) are described.

Several phyletic lines are represented amongst these fourteen species, which include H. cinereus, a species once thought to represent one of the basic types from which the present-day species-flock had evolved. Evidence now available suggests that, anatomically, H. cinereus is not sufficiently generalized to retain this distinction. Notes are given on the feeding habits and bionomics of the species.

3838. Tiews, Klaus. 1960. BESTIMMUNG DES ALTERSAUFBAUES DES ROTEN THUNES (THUNNUS THYNNUS (LINNAEUS)) IN DER NORDSEE MIT HILFE DES ALLOMETRISCHEN WACHSTUMS DER AUGENHOHLE. Archiv Fur Fischereiwissenschaft, Vol. XI, No. 1, pp. 11-17.

In 1959, the relationship between eye-diameter and fork length of 1607 bluefin tuna of the North Sea was studied. Three groups of tuna clearly distinguished by their eye diameter, could be separated by the graphical representation of the data. It is very likely that the three groups correspond with year classes 1945, 1946 and 1947, respectively with age groups XIV, XIII and XII as could be concluded from the age determinations of various authors. The year classes XII, XIII and XIV had the shares of 29.0%, 61.0% and 10% on the total German tuna landings in 1959 which amounted to 3,818 fishes. The age groups XII-XIV are defined by eye-diameters of 55-58 mm, 59-62 mm and 63-66 mm. (Auth. summ.)

3839. Irie, Takaaki. 1960. THE GROWTH OF THE FISH OTOLITH. Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima University, Vol. 3, No. 1, pp. 203-221.

Lateolabrax and Mylio were reared through all seasons in tanks and the temperature of the sea water, its concentration and the amount of food were variously changed. For the observation of the crystal texture of the otolith surface, the electron microscope was used and details concerning the formation of the otolith zone were studied through the autoradiographs. Radioactive isotope Ca^{45} was used as a tracer in order to measure the amount of calcium deposited upon the otolith surface, and, concerning the crystal texture of the annual rings, Argyrosomus was used instead of Lateolabrax and Mylio for convenience sake, and their Laue photographs were taken by the micro-beam X-rays.

Calcium dissolved in the sea water is deposited on the surface of the otolith, and micro-crystal grains of $CaCO_3$ which are the main constituent of the otolith are thus formed.

In summer and autumn, in which the fish grows rapidly, a large amount of calcium is deposited on the otolith surface, and the micro-crystal grains of $CaCO_3$ are formed abundantly. A very little protein fills the groove between crystal grains. In this way, the wide translucent zone which contains a small amount of protein is formed.

In winter and spring, in which the fish grows slowly, a small amount of calcium is deposited and the micro-crystal grains are formed very slowly. Much protein fills the groove between crystal grains. This is the way in which the opaque zone containing much protein is formed. (From auth. summ.)

3840. Richardson, I. D., D. H. Cushing, F. R. Harden Jones, R. J. H. Beverton, and R. W. Blacker. 1959. ECHO SOUNDING EXPERIMENTS IN THE BARENTS SEA. Fishery Investigations, Series II, Vol. XXII, No. 9, 57 pgs.

By counting fish echoes on the CRT, a relationship was established between the catch in baskets of cod and the total voltage received from fish whilst the trawl was fishing. On the basis of this relationship, a survey method was developed which showed the movement of the cod population on to the banks between Bear Island and Spitzbergen in a period of about ten days; the movement was correlated with the movement of warm water on to the banks.

Signals from single dead fish were measured and it was found that a single cod of 80-90 cm was detectable (on the axis of transmission) down to 170 fathoms when towing and to 300 fathoms when steaming at 10 knots. A 20 cm cod could be detected at 20 fathoms when towing and at 50 fathoms when steaming at 10 knots. For fish of between 20 cm and 80 cm, there was a roughly linear relationship between re-

ceived signal and length (30μv were received from a 20 cm cod and 230μv were received from an 80 cm cod). A reasonable approximation is that a 70 cm cod gives the same signal as an 8" diameter steel trawl float.

A weight was dragged on a wire by the drifting ship over the bottom and from the wire a trawl float was tied two fathoms from the weight. As the wire angle increased, the signal from the trawl float on the CRT moved towards the bottom signal and merged with it. The true height of the float from the bottom was approximately known, its apparent height was measured on the CRT and the true depth of water was known. From these measurements the angle made by the float to the transducer was calculable and them amplitude, measured on the CRT in μv, was plotted against this angle. From such regressions, it was possible to calculate a "standard signal" from the trawl float, as at one fathom from the transducer on the axis (1.9×10^5 μv). An analysis of fingernail traces from single fish (probably 60 cm cod) at different depths yielded an estimate of the "standard signal" of 1.5×10^5 μv, which is very close to that measured from the trawl float.

The quantitative use of the echo sounder is new. The three sets of experiments described in this paper, on the catch/signal relation, on signals from single fish and on the correspondence of the "standard signal" as measured from a trawl float and as estimated from single fish traces, lead us to conclude that there is reasonable justification for treating the echo sounder as a quantitative instrument. To obtain these results, variations in power output, in water noise and in the electrical characteristics of the instrument, must have been comparatively small. (From auth. concl.)

3841. Simpson, A. C. 1959. THE SPAWNING OF THE PLAICE (PLEURONECTES PLATESSA) IN THE IRISH SEA. Fishery Investigations, Series II, Vol. XXII, No. 8, 30 pgs.

By means of successive fish-egg surveys, the main spawning areas of the plaice in the Irish Sea were located off the north coast of Cornwall in Cardigan Bay, off Great Orme's Head (N. Wales) and between the Isle of Man and the coast of Cumberland. Small numbers of plaice eggs were also found at several points along the coast of Ireland and in Caernarvon Bay.

Spawning was found to have recently started in all areas by the end of January and was still continuing actively at the end of March.

Estimates have been made of the number of plaice eggs laid in the Irish Sea in 1953 and the number of females that had taken part in the spawning.

The relative distributions of old and young plaice eggs indicated the presence of a clockwise eddy in Cardigan Bay.

Samples of mature plaice from the spawning areas showed the males to be largely group II and III fish with a considerable proportion of group I males in Cardigan Bay and off Cornwall, and the females to be largely group II, III and IV fish with a greater proportion of older fish in the north than the south. (Auth. summ.)

3842. Ball, J. N., and J. W. Jones. 1960. ON THE GROWTH OF THE BROWN TROUT OF LLYN TEGID. Proceedings of the Zoological Society of London, Part 1, Vol. 134, pp. 1-41.

The age of Llyn Tegid trout can be reliably determined from the scales by counting the number of completed winter bands. The winter rings are formed annually in September-October. The seasonal growth pattern of lake trout has been investigated by examination of the scale structure each month and by following the monthly changes in the mean lengths of each year-class. Growth is confined to the period February-March to September-October, no growth taking place during the winter. Annual growth has been studied by determining the mean length of trout at the beginning of each year of life. The mean specific growth rate in the lake and streams declines with age and its negative acceleration decreases with age. Growth in Llyn Tegid and the neighbouring streams has been compared with growth in other British waters. Growth in the tributary streams is better than in the moorland streams but poorer than in the lake. Trout show an increase in growth rate when they migrate from the tributary streams to the lake. The length-weight relationship is the same for trout of all ages and in all the localities studied. Seasonal changes in the usual condition factor, K, are correlated with the amount of reserve fat stored around the stomach and pyloric caeca. (From auth. summ.)

3843. Nagata, Shun-ichi. 1959. SOME RESULTS OF THE TAGGING EXPERIMENTS ON YELLOWTAILS IN THE JAPAN SEA. Bulletin of the Japan Sea Regional Fisheries Research Laboratory, No. 7, pp. 43-57.

A study was made on the migration of the yellowtail, Seriola quinqueradiata in the Japan Sea making use of the tagging data during the period from 1955 to 1958. In total, 2,350 yellowtails were tagged, of which 62 were returned, giving the recovery rate as 2.6%. This rate of recovery is very low as compared with 9.3% obtained for the tagging experiments of the same fish during the period from 1918 to 1937.

The recovery rate in small-sized yellowtails is lower than that in large ones.

Eighty per cent of the returns were made within 30 days after release and returns made over a hundred days after release constituted only eight per cent of the total returns.

Though a minor part of yellowtails tagged in winter in the adjacent waters of Ryotsu Bay, Toyama Bay and Wakasa Bay stayed in each bay, the majority swam clockwise along the coasts of the bays, and that those which moved out of the bays into the open sea showed a southward migration along the coasts of Honshu.

3844. Shimomura, Toshimasa. 1959. EFFECTS OF THE TYPHOON "RUTH" (1951) UPON THE SEA CONDITIONS AND FISHING. Bulletin of the Japan Sea Regional Fisheries Research Laboratory, No. 7, pp. 109-118.

The typhoon "Ruth" landed in the south of Kyushu at night on October 14, 1951 and moved northeastward and reached the Japan Sea off San'in in the early morning of the 15th. Then she moved on the First (or Neritic) Branch of the Tsushima Warm Current along the Honshu, losing her characteristics as typhoon at night in Akita Pref.

The water temperature, throughout the neritic coasts of the Tsushima Warm Current, fell by 1°C. to 2°C. just after the typhoon, and the cold water masses of the offshore region were brought closer to land. Salmon, red sea bream, mackerel, yellow tail, dolphin and flounders were caught in larger quantities after the typhoon. Dog fish and sword fishes decreased.

On the northern coasts of Kyushu, mullet, gobius, squillae, shrimps, mackerel, small red sea bream, and crimson tai were caught in larger quantities.

In the Sanriku district facing the Pacific, the catch of mackerel by settled nets and anchovy by surrounding nets have increased, but common squid by angling, and tunas by surrounding nets decreased to almost nothing. (From auth. abst.)

3845. Chambers, Gilbert V., and Albert K. Sparks. 1959. AN ECOLOGICAL SURVEY OF THE HOUSTON SHIP CHANNEL AND ADJACENT BAYS. Publications of the Institute of Marine Science, Vol. 6, pp. 213-250.

An ecological survey of the Houston Ship Channel and adjacent bays was initiated in the summer of 1957 with data collected at frequent regular intervals. This report includes the comparison of data on temperature, chlorinity, dissolved oxygen, and related quantities with data on fish, shrimp, and crabs caught in trawls. Data are also given on currents, bottom cores, and organic content of sediments. (From auth. abst.)

3846. Ragotzkie, Robert A. 1959. PLANKTON PRODUCTIVITY IN ESTUARINE WATERS OF GEORGIA. Publications of the Institute of Marine Science, Vol. 6, pp. 146-158.

Primary production of the plankton community in the estuarine waters near Sapelo Island, Georgia was estimated by oxygen evolution in light and dark bottles at several locations. Data on temperature, light and chlorophyll *a* were obtained for most of the experiments. The average gross production by plankton was +0.68 gm C/m^2/day, and net planktonic community production averaged -0.038 gm C/m^2/day. The plankton community tended to be heterotrophic in the summer and autotrophic in the winter. The primary factor limiting production was light. Analysis of compensation depths and extinction coefficients shows that for the mean depth of these waters and under the observed conditions of light and vertical mixing, net production by the plankton community must be near zero regardless of the standing crop. The salt marsh is postulated as an outside source of organic matter of the system. (Auth. abst.)

3847. McFarland, William N. 1959. A STUDY OF THE EFFECTS OF ANESTHETICS ON THE BEHAVIOR AND PHYSIOLOGY OF FISHES. Publications of the Institute of Marine Science, Vol. 6, pp. 23-55.

The anesthetic effects of 21 chemicals were tested on the teleosts, Fundulus parvipinnis, Girella nigricans, and Paralabrax clathratus. Fifteen of the chemicals tested (ethyl alcohol, tertiary butyl alcohol, methylparafynol, chloral hydrate, chlorobutanol, tribromoethanol, sodium amytal, barbital phenobarbital, tricaine methanesulfonate, urethane, meprobamate, chlorpromazine, and magnesium sulphate) induced similar behavioral patterns in the species tested, while six (morphine sulfate, reserpine, azacyclonal, iodoacetate, sodium cyanide, and sodium bromide) had no visible effects or were toxic. In the behavioral pattern were observed four major stages: (1) sedation; (2) loss of equilibrium; (3) loss of reflex reactivity; and (4) medullary collapse. The anesthetic sequence observed for fishes is similar to that described for higher vertebrates.

Functions such as opercular rate, pectoral fin rate, cardiac rate, and metabolic rate were related to the various stages of anesthesia. It is suggested that measurements of metabolism of fishes in mild anesthesia (sedation) are reliable estimates of basal metabolic rates. The metabolic costs of maintaining equilibrium and integration of the organ systems in Fundulus are discussed.

It is shown that a given depth of anesthesia can be maintained in a fish for periods from 12 to 24 hours and often to 47 hours by carefully controlling the concentration of anesthetic dissolved in the medium. Variables, such as temperature, acidity, ionic constitution of the medium, and the size of fish affect the rate of induction and the depth of anesthesia. (Auth. abst.)

3848. Hubbs, Clark, and George E. Drewry. 1959. SURVIVAL OF F_1 HYBRIDS BETWEEN CYPRINODONT FISHES, WITH A DISCUSSION OF THE CORRELATION BETWEEN HYBRIDIZATION AND PHYLOGENETIC RELATIONSHIP. Publications of the Institute of Marine Science, Vol. 6, pp. 81-91.

Hybrids were produced by artificially mixing the gametes of five cyprinodont fishes. Hybrid survival varied dependent upon which species was the maternal parent. Fundulus similis by F. grandis hybrids did not survive the hatching period if F. similis eggs were used, but survival of the reciprocal was very high. Greater hybrid survival was obtained when the parents were more closely related. Although survival was low, one Fundulus by Cyprinodon hybrid hatched and ingested food.

These results correlate with those reported by other authors, that the level of development of hybrids correlates with the relationship of the parental species. A few apparent discrepancies involve hybrids whose parents are probably more closely related than shown in current taxonomic references. (Auth. abst.)

3849. Simmons, Ernest G., and H. Dickson Hoese. 1959. STUDIES ON THE HYDROGRAPHY AND FISH MIGRATION OF CEDAR BAYOU, A NATURAL TIDAL

INLET ON THE CENTRAL TEXAS COAST. Publications of the Institute of Marine Science, Vol. 6, pp. 56-80.

Cedar Bayou Pass, a natural tidal inlet on the Texas Coast, was the subject of studies in 1950-1951 and 1957-1958. In 1950-1951, when the pass was open, it was utilized extensively by fishes, crabs, and shrimp as a passageway to and from the Gulf of Mexico. Most movement was nocturnal and more fish moved to the gulf than to the bay. The fish taken in largest numbers was the Atlantic croaker which migrated gulfward during summer months. Sea trout were frequently captured but these were normally following schools of shrimp. Outward movement of southern flounder was intense during fall months but the expected heavy migration of redfish and black drum did not occur.

In 1957-1958, when the pass was closed, many of the same species were found. These normally appeared at a later date than when the pass was open. Many typical gulf species were not present in 1958.

It is suggested that discharge from the Guadalupe River, together with northers, is responsible for maintaining this inlet and that it is prone to close during periods of drouth. (Auth. abst.)

3850. Ishio, Shinya. 1960. THE REACTIONS OF FISHES TO TOXIC SUBSTANCES---II. THE REACTIONS OF FISHES TO ACIDS. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 9, pp. 894-899.

This paper deals with the method of avoidance tests of fishes applying the new tank, in combination with the reactions of Gin-buna, Carassius auratus (L.) and bluegill sunfish, Lepomis macrochirus to acid gradients resulted from adding hydrochloric acid to soft water and hard water. Some data to those tests proved the fact that against pH gradient, Gin-buna were able to approach acid water with pH as low as 2.8 when the concentration of carbonic acid was lower than 18 p.p.m., whereas bluegill sunfish could approach only pH 5.8 where the concentration of carbonic acid was 240 p.p.m. Although the pH 2.8 for Gin-buna and the 240 p.p.m. of carbonic acid for bluegill sunfish are presumed to be quickly fatal, it is safe to say that those fishes can avoid fatal concentrations of either hydrogen ion or carbonic acid with a high frequency more than 70 per cent of total avoidance. (Auth. abst.)

3851. Morita, Tomokazu. 1960. FISHING-GROUND CONSTITUTIONAL STUDIES ON THE WHITE MARLIN, MARLINA MARLINA JORDAN AND HILL, OVER THE EAST CHINA SEA---I. ON THE FISHING-GROUND CONSTITUTION OCCURRING WITH THE SEASONAL CHANGE OF THE ENVIRONMENT. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 9, pp. 887-893.

There are two chief environmental factors, biological and non-biological, in the fishing-ground constitution of white marlin over the East China Sea; the former consists of the distribution of mackerel and horse-mackerel and the latter consists of the effect variations of Kuroshio-warm-current and the Continent-coastal cold water mass.

The white marlin migrates over to the East China Sea not in order to spawn but in order to feed on mackerel and horse-mackerel. The fishing ground in winter covers the southern Kuroshio sea front which is adjoined to the mackerel fishing ground; and in spring and summer it changes in accordance with the rise of the water temperature, towards the central and northern sea front, which is overlapped with the mackerel fishing ground. In autumn it changes in accordance with the lowering of the water temperature, along the mackerel fishing ground, towards the southern sea front.

It is concluded that the constitution of the white marlin fishing ground is, so long as the white marlin may adapt itself to the sea conditions, apt to be subjected to the biological factors such as the distributions of mackerel and horse mackerel rather than the sea conditions. (Auth. abst.)

3852. Hiyama, Yoshio, Yukio Nose, Makoto Shimizu, Junko Matsubara, Koshi Onodera, Yasuo Kodama and Norio Suzuki. 1960. PREDATION OF RAINBOW TROUT FRY TRACED BY RADIO-ISOTOPE. Bulletin of the Japanese Society of Scientific Fisheries, Vol. 26, No. 9, pp. 863-867.

Onodera and others have investigated the reduction of number of trout fry after liberation since 1957, but the cause of the reduction was not known yet. In 1959's investigation, Hiyama and others joined to assure the role of predation by using radio-isotope. Among 2034 individuals of rainbow trout fry liberated (small size group 1.2gr., large size group 2.7 gr. average), just a half of them was injected at back muscle by $^{65}ZnCl_2$ solution (1μc/0.03cc per individual). Mortality rate and growth were not affected by treatment. Water, soil, plants and animals in the vicinity were surveyed frequently after the liberation, but no radio-activity was found except adult trout survived since last year and the excretion of a bird.

After 57 days following liberation when the last adult trout was taken (11 ind. altogether), it was enumerated that 33.5 individuals of fry were taken by adult trout, and 1140 by a couple of birds nesting near the liberation point. On the other hand, Onodera and others enumerated that 782 ind. of trout fry survived at that day by test fishing. So, the reduction of trout fry since liberation was 2034-782=1252 individuals. Among them 94% was caused by predation by eleven adult trout and a couple of birds, and 97% of predation was by the latter. (From auth. abst.)

3853. Herald, Earl S., Walter Schneebeli, Norval Green, and Kenneth Innes. 1960. CATCH RECORDS FOR SEVENTEEN SHARK DERBIES HELD AT ELKHORN SLOUGH, MONTEREY BAY, CALIFORNIA. California Fish and Game, Vol. 46, No. 1, pp. 59-67.

Data are presented on the 2,273 elasmobranch fishes caught at the 17 shark derbies held at Elkhorn Slough, Monterey Bay, California (1951-1959). In order of abundance there were 1,071 bat rays (Myliobatis californicus), 636 shovelnose guitarfish,

(Rhinobatos productus), 546 leopard sharks (Triakis semifasciata), 10 round stingrays (Urolophus halleri), 5 gray smoothhounds (Mustelus californicus), 3 brown smoothhounds (Rhinotriacis henlei) and 2 thornbacks (Platyrhinoidis treseriata). Elkhorn Slough was indicated as the northernmost extent of range for the round stingray, gray smoothhound and thornback.

A new record weight of 209 pounds was recognized for the bat ray. Females of this species weighed 50 pounds before achieving sexual maturity, whereas the males rarely weighed more than 27 pounds, and are probably matured at 10 pounds.

The shovelnose guitarfish had an atypical sex ratio with almost two females for every male. The largest male weighed 19 pounds and the largest female 29.

Male leopard sharks usually did not weigh more than 21 pounds and the maximum for females was 35. (Auth. summ.)

3854. Norris, Kenneth S., Frank Brocato, and Frank Calandrino. 1960. A SURVEY OF FISH TRANSPORTATION METHODS AND EQUIPMENT. California Fish and Game, Vol. 46, No. 1, pp. 5-33.

The transport of live fishes is becoming an increasingly important problem. Fish and Game agencies, aquariums, commercial bait dealers, commercial fishermen and people catering to the home aquarium trade all must transport living fish. In general, all wish to carry as many fish as possible in as little water as possible with a minimum of mortality. These attempts inevitably bring all the factors limiting to fish during transport into sharp relief. Much further improvement in transport efficiency seems possible.

As a foundation for the development of new equipment and methods at Marineland of the Pacific, we have attempted to gather all available information on present fish transportation practices. Ninety-six state, federal government and private agencies and individuals have been polled for transport data. The published literature has been reviewed. From these sources and from our own experiences we have compiled this review. The discussion has been limited primarily to principles and methods. Construction methods are not reviewed in detail, except where they have a direct bearing upon the welfare of the fish being transported. Where noteworthy information was derived from the poll, appropriate source notations are cited in parentheses. Literature references are given in normal fashion. (Auth. intro.)

3855. Swift, D. R. 1960. AN IMPROVED FEED FOR EXPERIMENTAL FISH. Nature, Vol. 187, No. 4743, Sept. 24, 1960. p. 1133.

Fouling the water in aquaria with minced liver can be avoided by previously salting with 5 gm. of salt per pound of liver, and mixing with 120 c.c. of a 33 percent solution of gelatine. The whole is allowed to set and then reminced before feeding.

3856. Tanner, W. F. 1960. EXPANDING SHOALS IN AREAS OF WAVE REFRACTION. Science, Vol. 132, No. 3433, 14 Oct. 1960, pp. 1012-1013.

Shoals and spits may grow seaward, despite powerful refracted wave attack, where the wave energy level is too low to handle the supply of sand introduced by the littoral drift. Spits and shoals of this type have distinctive shapes. They may support ripple marks which do not parallel the crests of the waves which form them. (Auth. abst.)

3857. Goldman, C. R. 1960. MOLYBDENUM AS A FACTOR LIMITING PRIMARY PRODUCTIVITY IN CASTLE LAKE, CALIFORNIA. Science, Vol. 132, No. 3433, 14 Oct. 1960, pp. 1016-1017.

A trace-element deficiency is evident from carbon-14 bioassays of Castle Lake's natural phytoplankton populations. Increase in photosynthetic rates with the addition of molybdic acid or sodium molybdate has been demonstrated throughout the year. It is likely that other trace elements may also be found to be limiting factors in lakes having a limited watershed. (Auth. abst.)

3858. Rothschild, Brian J. and Earl E. Deubler, Jr. 1960. PARALICHTHYS SQUAMILENTUS JORDAN AND GILBERT FROM NORTH CAROLINA. Copeia, No. 3, Sept. 26, 1960, pp. 254-255.

A northerly extension of the known range of P. squamilentus is provided by recent collections of young and juvenile specimens, in the waters of North Carolina.

3859. Allen, George H., and Gerald A. Sanger. 1960. FECUNDITY OF RAINBOW TROUT FROM ACTUAL COUNT OF EGGS. Copeia, No. 3, Sept. 26, 1960, pp. 260-261.

This paper records the fecundity of 17 accidentally killed rainbow trout as determined by actual count of eggs, and compares their fecundity with 31 additional females of the same brood spawned artificially.

3860. Northcote, T. G. 1960. RELATIONSHIP BETWEEN NUMBER OF PYLORIC CAECA AND LENGTH OF JUVENILE RAINBOW TROUT. Copeia, No. 3, Sept. 26, 1960, pp. 248-250.

Apparently there is little conclusive evidence in the literature of number of pyloric caeca being correlated with length of fish, however, most studies dealing with caecal counts have only treated larger juveniles or adult individuals. In the case of rainbow trout fry, it is evident that for comparative purposes caecal counts preferably should be made on individuals larger than 40 mm. A correlation between body length and number of pyloric caeca may well occur in young of other species. The possibility of such a relationship should be considered when caecal counts are used for racial distinction between juvenile fish.

3861. McAllister, D. E. 1960. A SIMPLE CLAMP TO AID IN COUNTING FIN RAYS. Copeia, No. 3,

Sept. 26, 1960. p. 250.
Two models of the fin clamp are described.

3862. French, Robert R. 1960. RAINBOW TROUTS, SALMO GAIRDNERI, WITH ANOMALOUS CAUDAL AND PELVIC FINS. Copeia, No. 3, Sept. 26, 1960, pp. 247-248.
The object of this note is to describe in Salmo gairdneri an unusual caudal fin in the "steelhead" stage, and three pelvic fins in two wild rainbow trout.

3863. Speare, Edward P. 1960. GROWTH OF THE CENTRAL JOHNNY DARTER, ETHEOSTOMA NIGRUM NIGRUM (RAFINESQUE) IN AUGUSTA CREEK, MICHIGAN. Copeia, No. 3, Sept. 26, 1960, pp. 241-243.
Age and growth of 556 specimens taken in the fall of 1957 is reported. Included is a comparison of growth of 1957 and 1958 fry.

3864. Branson, Branley A., Clarence J. McCoy, Jr., and Morgan E. Sisk. 1960. NOTES ON THE FRESHWATER FISHES OF SONORA WITH AN ADDITION TO THE KNOWN FAUNA. Copeia, No. 3, Sept. 26, 1960, pp. 217-220.
The authors undertook a general collecting expedition to Sonora, Mexico, in August, 1959. With the exception of its Southwestern tip this state is an extremely arid region most of the year. Since August is the rainy season, collecting is difficult for one unfamiliar with the intermittent nature of the streams. Seventeen species of fishes were taken in 10 streams, although collections were attempted in every body of water encountered. The following species were taken: Dorosoma smithi, Catostomus insignis, Catostomus wigginsi, Arius liropus, Ictalurus melas, Agosia chrysogaster, Gila purpurea, Gila ditaenia, Cyprinus carpio, Campostoma ornatum, Poeciliopsis accidentalis, Elops affnis, Mugil curema, Neomenis novemfasciatus, Lepomis macrochirus, Cichloasoma beani, and Dormitator latifrons. Number of specimens and range in lengths are given.

3865. Rosen, Donn Eric, and Joan R. Mendelson. 1960. THE SENSORY CANALS OF THE HEAD IN POECILIID FISHES (CYPRINODONTIFORMES), WITH REFERENCE TO DENTITIONAL TYPES. Copeia, No. 3, Sept. 26, 1960, pp. 203-210.
The presently observed close correlation between development of the sensory canals of the head and dentitional types in Poeciliidae suggests that the cephalic canals (but not the lateralis system as a whole) are somehow employed by these fishes in feeding. Field and laboratory observations reveal that many fishes with open canals and strong teeth are predominantly surface feeders and that those with closed canals and movable teeth forage a good deal on the bottom. Opening of the canals exposes the neuromasts directly to the environment. Thus a carnivore moving about at the surface would have its exposed neuromasts almost if not in contact with the surface film. Disturbances on the surface caused by trapped insects would probably be sensed more rapidly than if the canals were closed over. Exposed neuromasts, however, may provide a means of rapid sensing of vibrations whether at the surface or below and be especially suited to the rapid location by a carnivore of its prey. (From auth. disc.)

3866. Witt, Arthur, Jr. 1960. LENGTH AND WEIGHT OF ANCIENT FRESHWATER DRUM, APLODINOTUS GRUNNIENS, CALCULATED FROM OTOLITHS FOUND IN INDIAN MIDDENS, Copeia, No. 3, September 26, 1960, pp. 181-185.
The mean lengths of present day freshwater drum, in the vicinity of aboriginal sites, are generally smaller than the mean lengths of fish from the aboriginal sites.
The relatively small size of recent freshwater drum in the Mississippi River is probably due to a combination of factors: alteration of the environment and food supply by the drainage of bottom land lakes; construction of navigation dams with resultant silting; water pollution. Cropping by the sport and commercial fisheries would also be important.
The maximum size of Aplodinotus grunniens is reported to be 4 feet in length and 60 pounds (Jordan and Evermann, 1898). Hubbs (in litt.) and Hubbs and Lagler (1958) estimated that this species may have attained a weight of about 200 pounds during primordial times. This was an estimate based upon lower pharyngeal arches taken from middens in the Gulf States and compared with pharyngeal arches from a recent 20 pound specimen. A direct relation was assumed for length and a cube relation for weight. One would reason that out of nearly 500 otoliths from aboriginal times, which were examined in this work, a few of them would have represented unusually large specimens of this species. This, however, was not the case and leads me to believe that the maximum size of this species is probably well under 100 pounds. (From auth. disc.)

3867. Briggs, John C. 1960. FISHES OF WORLD-WIDE (CIRCUMTROPICAL) DISTRIBUTION. Copeia, No. 3, Sept. 26, 1960, pp. 171-180.
The purpose of this contribution is to call attention to those forms which are apparently worldwide in distribution, in the hope that they may receive additional consideration. It should be emphadized that the majority of the species mentioned in this work have not been subjected to recent systematic appraisal. Consequently, it is expected that this list will undergo considerable change in the near future.
The annotated list of 107 species includes only those which, according to the present state of our knowledge, form homogeneous species populations extending entirely around the world in tropical or temperate waters. Fishes that seem to be worldwide at the species level but that apparently break up into subspecific populations in parts of their range are not included. Under each species are listed only those recent references that seem to give a reasonably good indication of circumglobal distribution. In many instances, these references are reinforced by the citation of a definite record from the Eastern

Pacific area. Several species have been listed for which no Indian Ocean captures are yet known. Presumably, this is a reflection of the paucity of collections from that region rather than an actual discontinuity in the range of the species. (From auth. intro.)

3868. Healy, Ann and Michael Kennedy. 1958. TROUT IN LOUGH GLORE CO., WESTMEATH, IRELAND. The Salmon and Trout Magazine, No. 153, May 1958, pp. 102-114.

Material consisting of 208 sets of brown trout scales together with relevant data was used to determine the growth rate and conditions of trout in an 87-acre limestone lake in Co. Westmeath. The stomach contents of 50 trout were examined and the nature of the food was determined. A total of 316 fish were tagged in the lake with flat celluloid tags and freshwater smolt tags over a period of years and 100 were recaptured. A rough estimate of the number of redds was made in the rivers and stream during the spawning season 1954-55. In early March 1955, 1,101 trout were marked in the Glore system--rivers, stream and lake by fin clipping, and the insertion of coloured braided nylon in front of the dorsal fin to determine the population size and distribution.

The calculated growth rate compared favourably with that from other alkaline waters in the country. The greatest increment in length was made in the second year of life. The most important food consisted of chironomid pupae, Asellus aquaticus, and Gammarus duebeni. A very high proportion of the fish tagged with flat celluloid tags and freshwater smolt tags was recovered from the stomachs of pike. The population of the rivers and stream was estimated at 5,619 and the figure for the lake at 2,782--the latter figure is not considered representative. (Auth. summ.)

3869. Prakash, A., and James R. Adams. 1960. A HISTOPATHOLOGICAL STUDY OF THE INTESTINAL LESIONS INDUCED BY ECHINORHYNCHUS LAGENIFORMIS (ACANTHOCEPHALA--ECHINORHYNCHIDAE) IN THE STARRY FLOUNDER. Canadian Journal of Zoology, Vol. 38, No. 5, pp. 895-897.

Echinorhynchus lageniformis Ekbaum, 1958, a common acanthocephalan parasite of the starry flounder, causes extensive damage to the intestinal wall of the host. The female parasite appears to penetrate more deeply than the male and induces formation of a chronic nodular outgrowth outside the intestinal wall. A histopathological study of the early and advanced lesions is reported. (Auth. abst.)

3870. Kinnear, J. E. 1960. THE MINIMUM DOSAGE OF THIOUREA EFFECTIVELY INHIBITING THYROXINE SYNTHESIS IN THE FLOUNDER (PLATICHTHYS STELLATUS). Canadian Journal of Zoology, Vol. 38, No. 5, pp. 917-922.

Thiourea in concentrations of 0.0025%, 0.005%, 0.01%, 0.02%, and 0.03% prevented the synthesis of thyroxine by the thyroid gland of the starry flounder (Platichthys stellatus). Concentrations of 0.001%, 0.0005%, and 0.0001% thiourea were not inhibitory. Concentrations of 0.005%-0.03% thiourea were effective for over 9 weeks. Flounder exposed to thiourea retained relatively little I^m in their thyroids. Although the synthesis of thyroxine was completely blocked by the inhibiting concentrations of thiourea, some synthesis of monoiodotyrosine and diiodotyrosine occurred. (Auth. abst.)

3871. Ronald, Keith. 1960. THE METAZOAN PARASITES OF THE HETEROSOMATA OF THE GULF OF ST. LAWRENCE. Canadian Journal of Zoology, Vol. 38, No. 5, pp. 923-937.

Aporocotyle simplex, Brachyphallus crenatus, Cryptocotyle lingua, Derogenes varicus, Genolinea laticauda, Gonocerca crassa, Hemiuris appendiculatus, H. communis, H. levinseni, Hemiuris sp., Lepidapedon rachion, Otodistomum veliporum, Peracreadium commune, Plagioporus varia, Podocotyle atomion, P. olssoni, Prosorhynchus squamatus, Steganoderma (Steganoderma) formosum, Stanakron vetustum, Stephanostomum baccatum, Steringophorus furciger, Steringotrema cluthense, and S. pagelli were identified in a study of 560 specimens of Heterosomata (Hippoglossoides platessoides, Hippoglossus hippoglossus, Limanda ferruginea, Liopsetta putnami, Pseudopleuronectes americanus, and Scophthalmus aquosus) from the Gulf of St. Lawrence area. Host distribution is indicated, together with parasitic incidence. (Auth. abst.)

3872. Margolis, L. 1960. A NEW NEMATODE OF THE GENUS CUCULLANUS (CAMALLANATA: CUCULLANIDAE) FROM A FLOUNDER, PAROPHRYS VETULUS GIRARD, 1854, WITH NOTES ON THE SPECIES FROM PLEURONECTIFORMES. Canadian Journal of Zoology, Vol. 38, No. 5, pp. 839-849.

Cucullanus annulatus, parasitic in the intestine of the pleuronectiform fish Parophrys vetulus Girard from coastal waters of British Columbia, is described. The species of Cucullanus known from Pleuronectiformes are reviewed. Cucullanus wülkeri Kreis is considered a synonym of C. heterochrous (Rudolphi). (Auth. abst.)

3873. Brunel, Pierre. 1960. ARTIFICIAL KEY TO THE MYSIDACEA OF THE CANADIAN ATLANTIC CONTINENTAL SHELF. Canadian Journal of Zoology, Vol. 38, No. 5, pp. 851-855.

A key is given for the identification of 16 species and one variety of Mysidacea recorded up to date in waters of the Canadian Atlantic continental shelf. Two species not yet recorded but likely to occur in these waters are also included. The key is to be used with Tattersall's Review of the Mysidacea of the U. S. National Museum (1951). Diagnostic characters of four species are illustrated. (Auth. abst.)

3874. Moulton, James M. 1960. SWIMMING SOUNDS AND THE SCHOOLING OF FISHES. The Biological Bulletin, Vol. 119, No. 2, pp. 210-223.

The swimming sounds of four schooling species

of Bermuda fishes are described. The sounds stem from streaming and veering of schools at sea. Responses of schooling species to playback of sounds stemming from schools are described. Exploitation of these responses in experimental and commercial fishing is suggested. On the basis of observation at sea and of laboratory experiments, mechanisms useful in maintaining formation of schools at sea are discussed. These include vision, water currents and pressure waves initiated by the movements of fish bodies and the sounds they engender. An African acoustical fishery, probably relying on the swimming sounds of fishes, is described.

3875. Deubler, Earl E., Jr. 1960. SALINITY AS A FACTOR IN THE CONTROL OF GROWTH AND SURVIVAL OF POSTLARVAE OF THE SOUTHERN FLOUNDER, PARALICHTHYS LETHOSTIGMA. Bulletin of Marine Science of the Gulf and Caribbean, Vol. 10, No. 3, pp. 338-345.

Study of the effect of a range of salinities on growth and survival of postlarvae of Paralichthys lethostigma Jordan and Gilbert under laboratory conditions indicates good survival without acclimatization in salinities ranging from $0^{o}/oo$ to $30^{o}/oo$. Growth appears to be influenced by salinity with greater weight increase per unit of time occurring under more saline conditions. (Auth. abst.)

3876. Riffenburgh, Robert H. 1960. A NEW METHOD FOR ESTIMATING PARAMETERS FOR THE GOMPERTZ GROWTH CURVE. Journal Du Conseil, Vol. XXV, No. 3, pp. 285-294.

The problem is to obtain an expression for the ideal growth curve of an organism (or other phenomenon) given a set of observations. Growth curves are discussed and the Gompertz curve posited. Methods for obtaining estimates of the Gompertz parameters are compared. Two new methods, both based on the same technique, are given. The long method provides estimates which converge in probability to the parameters as the sample size grows large, but involves a great deal of numerical calculation. The short method gives rapid and simple first approximations to the parameters, but is considerably less accurate.

A numerical example is given. Length data on yellowfin tuna from Hawaiian waters are analysed and an estimate of the growth curve is obtained; an estimate of the time of birth is also obtained so that length can be found as a function of age. (Auth. summ.)

3877. Tranter, D. J. 1960. A METHOD FOR DETERMINING ZOOPLANKTON VOLUMES. Journal Du Conseil, Vol. XXV, No. 3, pp. 272-278.

A simple modification of Ealey's method has been used to measure the volume of small plankton samples.

The coefficient of variation is less than 10 percent.

Depending on the faunal composition of the catch, one ml of "raw plankton" measured by this method contains between 20 and 160 mg dry matter.

It is suggested that comparison of data would be facilitated if conversion factors of this type were given for each method of measuring zooplankton volume and biomass. (Auth. summ.)

3878. Farris, David A. 1960. THE EFFECT OF THREE DIFFERENT TYPES OF GROWTH CURVES ON ESTIMATES OF LARVAL FISH SURVIVAL. Journal Du Conseil, Vol. XXV, No. 3, pp. 294-306.

Three different types of growth (exponential, logarithmic, arithmetic) were used in this study. The survival models resulting from the use of these do not show irregular changes in curvature of their survival curves which can be construed as indicative of critical periods. It is, therefore, believed that any change which occurs in a survival curve based on yearly abundance estimates by size-class must reflect conditions imposed on the estimate by the weighted counts of the size-classes.

Hjort's "critical period" hypothesis suggested that increased mortality should occur after yolk-sac absorption. The field data presented do not support this contention. On the other hand, evidence from the laboratory observations reported in the literature indicate increased mortalities after yolk-sac absorption. Environmental factors present in the sea such as predation, but not present in the laboratory may account for the discrepancy. Alternatively, the non-quantitative way in which most previous laboratory observations have been reported, may have lent to confusion as to when the higher mortalities actually do occur.

A comparison of mortality rates of sardine larvae taken from the field and laboratory data do not appear to be in conflict. Both indicate that heavy mortality occurs before complete yolk-sac absorption. Therefore, survival may be governed by the yolk supplied by the spawning females which could vary from year to year depending on the age and diet of the spawning females. (Auth. summ.)

3879. Brock, Vernon E., and Robert H. Riffenburgh. 1960. FISH SCHOOLING: A POSSIBLE FACTOR IN REDUCING PREDATION. Journal Du Counseil, Vol. XXV, No. 3, pp. 307-317.

The schooling of fish is considered as a mechanism for protection against predation. It is shown that the frequency of detection of prey by a predator is an inverse function of the number of schooled or grouped prey. The quantity of fish that a predator can consume on any single encounter with a school of prey has some average limit, and once school size exceeds this quantity, further increases in school size reduce the frequency of predator-prey encounters without necessarily changing the quantity of prey consumed on the occasion of each encounter, which in turn may reduce the rate of consumption of a prey species by a predator. (Auth. summ.)

3880. Zarnecki, St. 1960. RECENT CHANGES IN THE SPAWNING HABITS OF SEA TROUT IN THE UPPER VISTULA. Journal Du Conseil, Vol. XXV, No. 3, pp. 326-331.

The main spawning grounds of the big race of Vistula sea trout were located in the largest tributary of Upper Vistula, namely the river Dunajec, the system of which occupies an area of 6, 823 km^2. In recent years, however, the Dunajec has lost its predominance as a spawning area and the chief concentrations of spawners are now observed in the much smaller river Raba (1, 518 km^2), and in other tributaries of the Vistula in some of which sea trout have never before been observed (the rivers San and Rudawa).

Investigations have failed to reveal any inhibitive factors responsible for the decrease in the spawning runs in the river Dunajec.

A comparison between the number of spawners caught in the different tributaries and that of the fry and one-year-old parr liberated in them leads to the supposition that there must be a connection between the distribution of spawning runs and the number of fry and parr liberated.

On the basis of these phenomena the problem arises as to whether anadromous sea trout return not only to their main native river (the Vistula) but also to the tributaries in which they were hatched and liberated. (Auth. summ.)

3881. Phillips, Ronald C. 1960. ECOLOGY AND DISTRIBUTION OF MARINE ALGAE FOUND IN TAMPA BAY, BOCA CIEGA BAY AND AT TARPON SPRINGS, FLORIDA. The Quarterly Journal of the Academy of Sciences, Vol. 23, No. 3, pp. 222-260.

Marine algae in Tampa Bay, Boca Ciega Bay, and at Tarpon Springs were studied on monthly visits from September, 1957 to April 1959. One hundred and ninety-five taxa of algae are reported.

Nine stations, three each in Tampa Bay, Boca Ciega Bay, and at Tarpon Springs, were visited monthly to collect and observe plants and to record hydrographic information, e. g., water temperature, salinity, depth of water, stage and type of tide, water clarity, and substrate.

Eighty-six taxa of algae were found in Tampa Bay, 111 taxa were recorded in Boca Ciega Bay, and 95 taxa were listed from Tarpon Springs. Of the Tampa Bay flora 35% was limited to that bay, 32% of the Boca Ciega Bay flora was restricted to that bay, while 52% of the Tarpon Springs flora was limited to that area.

It was concluded that Tampa Bay exhibited a brackish water flora, that Boca Ciega Bay displayed a flora transitional between Tampa Bay and the marine flora found at Tarpon Springs. (From auth. summ.)

3882. Harder, Wilhelm. 1960. ZUR ANATOMIE DES DARMTRAKTES EINIGER GADIFORMES UND MACRURIFORMES (OSTEICHTHYES, PISCES). Kurze Mitteilungen, No. 10, pp. 1-41.

Twenty-six species of Gadiformes (16 genera with 22 species) and Macruriformes (four genera with one species each) have been investigated with respect to their intestines. The general shape of the small intestine is a Z-like loop, only Merluccius merluccius is an exception of this rule. The colon appears in two different shapes: a simple tube of the same diameter as the small intestine, or an ampulla. The relative lengths of the small intestine differ very much between the species; but there are no obvious relations to the kind of nutrition. The position of the intestine in the body cavity and its relations to the adjacent organs as well as the proportions of the subdivisions of the intestine itself permit to separate the different species and the higher systematic categories, though at the moment there seems to be no way to arrange the species in a phylogenetic way, as the number of species investigated is too small still. (Auth. summ.)

3883. Koops, Harald. 1960. DIE BEDEUTUNG DER STAUSTUFE GEESTHACHT FÜR DIE QUAPPEN-FISCHEREI DER ELBE. Kurze Mitteilungen, No. 10, pp. 43-55.

By large scale tagging experiments the course of the spawning-migration of burbots in the river Elbe was shown. The main part of the population lives in the lower part of the river and moves upstreams for spawning to the tributaries of the upper part, in a considerable amount up to the river Havel. The possibilities for ascent being shut by the Geesthacht dam, the population of burbots will be reduced to practical insignificance in future. No migration was found through the flood-gates in Geesthacht. (Auth.)

3884. Gieysztor, M. 1960. ON THE THERMAL CONDITIONS OF THE LITTORAL ZONE OF LAKES. Polskie Archiwum Hydrobiologii, Vol. VII, No. XX, pp. 171-193.

The temperatures in the littoral of our lakes differs very considerably from the temperatures of the surface water of the open lake. The character of the littoral temperatures corresponds in general with the character of the thermal conditions of water ponds. The minimum 24-hour temperatures in the littoral during the summer are higher than the minimum atmospheric temperatures and most frequently they are also higher in the spring. The maximum 24-hour temperatures during the warm months of the year considerably exceed the maximum 24-hour temperatures of the surface water of the open lake. During the late autumn, it is most probable that the temperatures on the open lake are often higher than the temperatures of the water near the shore. In the winter the temperatures of the open lake and littoral differ very little from each other. Thus, in the warmer months of the year the general character of the littoral temperatures indicates that they are higher than temperatures on the open lake whereas the 24-hour fluctuations, where the minimum temperatures are kept relatively high, do not affect the warm water nature of the littoral waters during the spring-summer period which is also particularly distinguished by high maximum temperatures.

The thermal character of the littoral may be very varied depending on development of its width, depth, on the extent to which it is isolated from the center of the lake or to which it is overshaded, on its exposure to sunlight, its degree of turbulence of stagnancy, and finally the vegetation present. (Auth.)

3885. Bernatowicz, S., and J. Radziej. 1960. QUANTITATIVE STUDIES ON THE VASCULAR FLORA OF LAKE DOBSKIE. (BADANIA ILOSCIOWE FLORY NACZYNIOWEJ JEZIORA DOBSKIEGO.) Polskie Archiwum Hydrobiologii, Vol. VII, No. XX, pp. 29-60.

The area covered by the plants is 433.4 hectares, which is 25.9 per cent of the lake's total area. Emersed plants account for 109 hectares (6.4 per cent), and submersed plants, for 324.4 hectares (19.5 per cent).

The over-all annual crop of vascular plants was in crude state 5,970,049 kg, and in dry state 1,375,866 kg.

Bathymetric distribution of plants averaged: at 1 m. or less - 29 per cent, 1 - 3 m - 44.4 p.c., 3 - 5 m - 26.4 p.c., 5 - 7 m - 0.2 p.c. The weight per hectare of overgrown area was 13,774 kg in crude state, and 3,174 kg in dry state.

Of emersed plants the most numbeous were Phragmites communis (71.77 p.c.), Typha angustifolia (19.18 p.c.), and Schoenoplectus lacustris (8.45 p.c.).

Species distribution of the crop of submersed plants was as follows: Charales sp. - 74.20 p.c., Ceratophyllum sp. - 12.05 p.c., Elodea canadensis - 6.45 p.c., and Lemna trisulca 2.48 p.c. All other plants accounted each for less than 1 p.c. of crude weight.

On littoral and mid-lake shallows, exposed to strong action of the wind, Parvocharaceetum and Potamogeton pectinatus predominated. Below the slope, where wave action is insignificant, Magnocharaceetum, Lemna trisulca, Ceratophyllum sp. and Elodea canadensis occurred in great masses. Plants with floating leaves - Nuphar luteum, Nymphaea alba, Potamogeton natans, and Stratiotes aloides - were found only in well sheltered bays. (Auth.)

3886. Lewis, William M., and R. M. Tarrant, Jr. 1960. SODIUM CYANIDE IN FISH MANAGEMENT AND CULTURE. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 177-180.

The "Cyanegg" is the most convenient form of sodium cyanide for use in fish work. In hatchery or other small ponds, the "eggs" are put in wire cages attached to a line extending across the pond and the cages are then towed back and forth and from side to side over the pond until the cyanide has dissolved. In large and irregular ponds, the "eggs" are placed in a bag and towed behind a boat until dissolved.

Sodium cyanide at 0.5 to 1.0 p.p.m. is very effective in the live removal of larger centrarchids. It is not, however, very effective for removal of carp (Cyprinus carpio) and bullheads (Ictalurus spp.). Sodium cyanide at 4.0 p.p.m. is the best choice for ridding hatchery ponds of tadpoles, fishes, crayfish, and at least some insects and snails.

Large lakes can be sampled with cyanide by closing off a cove with a sheet of polyethylene plastic. To obtain a complete sample, fish that float after the day of poisoning must be picked up.

Sampling pool-and-riffle-type streams with sodium cyanide produces a more complete sample than is obtainable by electrical shocking or seining. (Auth. abst.)

3887. Tiemeier, Otto W., and J. B. Elder. 1960. GROWTH OF STUNTED CHANNEL CATFISH. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 172-176.

Growth data are presented and comparisons made between a population of Ictalurus punctatus in an overcrowded pond and their siblings stocked in 8 other ponds over a period of 5 years. Data are also given for recovery growth of the original population after a program of supplementary feeding for one summer. (Auth. abst.)

3888. Wagner, John L., and W. L. Hartman. 1960. AN UNDERWATER CAMERA CASE. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 188-191.

An underwater camera case was built to house both a still camera and a motion-picture camera. Controls on both cameras can be manipulated under water. The case is pressurized with a SCUBA regulator and air-bottle arrangement that provides automatic adjustments to differences in water pressure at varying depths. Excellent photographs of spawning red salmon were obtained with this case. (Auth. abst.)

3889. Rasmussen, Delbert H. 1960. PREVENTING A WINTERKILL BY USE OF A COMPRESSED-AIR SYSTEM. Progressive Fish Culturist, Vol. 22, No. 4, pp. 185-187.

A compressed-air system used to remove part of the ice cover on a small high mountain cutthroat brood-stock lake is described. Air is circulated from a 75-cfm compressor through two 1,100-foot sections of plastic pipe. Pumping operations starting in November lasted 162 days at a cost of $950, exclusive of the operator's wages. Physical and chemical features of the lake during this period are described. The operation was successfully terminated in April. (Auth. abst.)

3890. Johnson, M. G., and W. H. Charlton. 1960. SOME EFFECTS OF TEMPERATURE ON THE METABOLISM AND ACTIVITY OF THE LARGEMOUTH BASS, MICROPTERUS SALMOIDES LACEPEDE. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 155-163.

The standard and active rates of metabolism measured as oxygen uptake were determined for a group of fingerling largemouth bass at temperatures from 5° to 29°C. The scope for activity obtained as the difference between the standard and active levels of metabolism was compared with food consumption and cruising speed as measured in an annular rotating chamber. Scope for activity, food consumption, and cruising speed increased with increasing temperature of 22°C., exhibiting a relationship near linear. No further significant change occurred in any criterion; and for practical purposes 22° to 29°C. apparently represented the optimum range for activity. Maximum activity was indicated at a temperature of 25°C. From

5° to 25°C., the latter being the temperature at which additional power was unavailable for further increase in activity, a twelvefold increase in scope for activity produced a fourfold increase in cruising speed.

No food was consumed at 5°C., where a very low scope for activity was observed. Above 22°C., the proportional rate of increase in food consumption of the test fish was quite markedly decreased by a similar change in scope for activity, although total metabolism continued to increase with no indication of leveling off. (Auth. abst.)

3891. Carufel, Louis H. 1960. EVALUATION OF COMMERCIAL FISHERY BY USE OF A QUESTIONNAIRE. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 181-184.

A 5-year study, 1953 to 1957, of the commercial catch was made with a questionnaire which resulted in a comparison of the commercial fishing-gear success and a tabulation of total pounds of fish taken. The questionnaire was sent to all license holders at the end of the calendar year. The number of returns for the 5-year period ranged from 377 to 1,005 (43.3 to 59.0 percent). Follow-up letters resulted in an additional return of 5.0 to 8.0 percent.

Set lines were utilized the most, with hoop nets and then seines, respectively. Total harvest for hoop nets was 245,508 pounds (61.0 percent); set lines, 149,979 pounds (31.0 percent); and seines, 8,785 pounds (2.0 percent). (Auth. abst.)

3892. Phillips, Arthur M., Jr., D. L. Livingston, and R. F. Dumas. THE EFFECT OF STARVATION AND FEEDING ON THE CHEMICAL COMPOSITION OF BROOK TROUT. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 147-154. 1960.

Brook trout were held in two water temperatures and either fed a standard hatchery diet or starved until excessive mortalities occurred in the starved groups. The experiments were continued for 12 weeks. At weekly intervals the trout were weighed and samples of fish preserved in formalin for chemical analysis.

Chemical changes in the composition of growing fish were correlated with time rather than with water temperature and fish size. Changes in the composition of starved trout were correlated with both time and water temperature. The plotting of changes in chemical composition of both fed and starved trout provided evidence of metabolic cycles within the trout body. (Auth. abst.)

3893. Hesser, E. F. 1960. METHODS FOR ROUTINE FISH HEMATOLOGY. Progressive Fish-Culturist, Vol. 22, No. 4, pp. 164-171.

Techniques for counting erythrocytes and leukocytes have been reviewed and evaluated. For routine erythrocyte counts, a diluting fluid developed by Hendricks had proved most effective, holding the cells in suspension and producing little or no variation in the cellular structure. The leukocyte and erythrocyte combination was most satisfactorily evaluated with a diluting solution developed for avian bloods. This diluent, used with certain aniline dyes, enabled a clear-cut differentiation between the erythrocyte, leukocyte, and thrombocyte. A new stain developed by the Hemal Stain Company was used for the differential blood films. This stain produced good nuclear and cytoplasmic contrast and decreased the original staining time of 5 to 20 minutes to a total of 20 seconds. Heparin was the most effective anticoagulant and caused the least variation in the cellular structures. The standard microhematocrit method was used on the fish blood with very satisfactory results. Hemoglobin from fish blood was determined by the Sahli-Hellige method using 0.1 N hydrochloric acid as a diluent. Blood samples from small fish were obtained by severing the caudal peduncle. Fish over six inches were anesthetized, and blood was taken by cardiac puncture. (Auth. abst.)

3894. Molnár, Gyula. 1960. METHODE DER BLUTENTNAHME FUR HAEMATOLOGISCHE UNTERSUCHUNGEN BEI FISCHEN. Zeitschrift Für Fischerei Und Deren Hilfswissenschaften, Vol. IX, Nos. 1, 2, pp. 101-106.

Author described the new heart tapping blood method, which he has used with several hundreds of fish.

With the introduction of the new method can be secured:

Blood can be taken quick without any difficulty or preparations (narcotization, narcosis).

The physiological condition of the blood is undisputable.

The customary maximal necessary quantity of blood, 1,5-3 ml for the haematological examinations can be obtained.

The fish does not perish, it is suitable for later blood taking, for further breeding, for sale and transportation alive. (Auth. summ.)

3895. Hnatevic, B. 1960. DAS WACHSTUM DES BARSCHES (PERCA FLUVIATILIS L.) IN DEM ORAVA-STAUBECKEN (SLOWAKEI). Zeitschrift Für Fischerei UND DEREN HILFSWISSENSCHAFTEN, Vol. IX, Nos. 1, 2, pp. 85-93.

In 1956 the author examined 258 perch (Perca fluviatilis L.) from the Orava-reservoir (Slovakia).

The relations between age and growth of the individual age groups were ascertained, tabulated and compared with the material of other authors. The importance of the perch for the practical utilization of the Orava-reservoir by fishery is discussed. (Auth. summ.)

3896. Müller, W. 1960. BEITRÄGE ZUR BIOLOGIE DER QUAPPE (LOTA LOTA L.) NACH UNTERSUCHUNGEN IN DEN GEWÄSSERN ZWISCHEN ELBE UND ODER. Zeitschrift Fur Fischeri. Und Deren Hilfswissenschaften, Vol. IX, Nos. 1 and 2, pp. 1-72.

Food researches revealed in accordance with literature great variations in edibility. The food utilization of Lota lota corresponds according to aquarium studies largely with that of Salmo irideus

and Esox lucius. The methods of determining the age of Lota lota are described in detail. Opaque otolith zones are formed in winter and hyalin otolith zones in summer. The influence of the sex and the attack by Diplostomum volvens on the growth could not be proved. The growth of Lota lota in the area studied is demonstrated. Lota lota grows also in winter. Bibliographical data on propagation conditions are completed by own observations. Statements on the pelagic behavious of eggs could not be made. Incubation is described and several stages of the fetal development are illustrated. Under natural conditions larvae capable of swimming and feeding were found end of March or beginning of April at the utmost border of a river overflowing its banks. Apart from waters having an intensive population of salmonidae or coregonidae Lota lota offers the following advantages: utilization of organisms usually less fed, such as odonata larvae and hirudinea, and favourable use of Osmerus esperlanus, Acerina cernua, Gobio fluviatilis and other small fish, utilization of the natural food offer, even in the coldest season and intensification of the catch and fish supply during winter.

3897. Frank, Stanislav. 1959. A CONTRIBUTION TO THE GROWTH OF THE COMMON BROWN TROUT (SALMO TRUTTA M. FARIO L.) IN KLÍČAVA VALLEY RESERVOIR. (PŘÍSPĚVEK K RŮSTU PSTRUHA OBECNÉHO F. POTOČNÍ (SALMO TRUTTA M. FARIO L.) V KLÍČAVSKE ÚDOLNÍ NÁDRŽI.) Věstník Československé Společnosti Zoologické, Vol. XXIII, No. 2, pp. 123-130.

The water surface of Klíčava Valley Reservoir in Middle Bohemia measures about 70 hectares, the reservoir is situated in a woody country. The dam was erected in 1952. The growth of trouts from Klíčava Valley Reservoir was faster than the growth rate from other water drainages. The coloration of all specimens examined was silvery without red spots, typical for common brown trout from brooks. The silvery coloration of their flanks was similar to the body colour of sea trouts of Danish origin, the eggs of which were imported from Denmark after the year 1945. Probably, some yearlings were planted also into the brook Klíčava before the erection of high dam, closing the reservoir. (From auth. summ.)

3898. Prokešová, Věra. 1959. HYDROBIOLOGICAL RESEARCH OF TWO NATURALLY POLLUTED POOLS IN THE WOODY INUNDATION AREA OF THE ELBE. (HYDROBIOLOGICKÝ VÝZKUM DVOU PŘIROZENĚ ZNEČIŠTĚNÝCH TŮNÍ V ZALESNĚNE INUNDAČNI OBLASTI LABE.) Věstník Ceskoslovenské Spolecnósti Zoologicke, Vol. XXIII, No. 1, pp. 34-69.

In 1955--1957 the author regularly (at least once in a month) examined the stratification of temperature, oxygen and hydrogen sulphide, pH values and alkalinity in two pools in the inundation area of the Elbe. The samples from different depths were taken in the deepest spots of the pools. In the year 1956/57 the values of organic and ammonia nitrogen and BOD were examined. The qualitative samples of plankton were taken in regular intervals; in some cases the stratification of plankton was tested, especially in regard for its dependence upon oxygen conditions. Laboratory experiments on Chaoborus larvae were made as to their resistance against hydrogen sulphide.

The pools are protected by their surroundings and their own flora from the wind to such an extent that it gives rise to an expressive stratification, and a total circulation is made difficult. The spring and autumn homothermia was not caused by mixing the water through wind action, because the dissolved substances remained constantly stratified (with one exception).

The decomposition of organic substances on the bottom is proceeding with maximum intensity at the end of summer at a high temperature, but the general oxygen conditions in the pools are worse in winter when the pools are frozen and the photosynthesis is restricted.

The contents of organic and ammonia nitrogen varies considerably during the year. At the bottom the ammonia nitrogen prevails over the organic one; the relations near the surface are inverse. The concentration of organic and ammonia nitrogen rises with the decrease of BOD and vice versa.

Hydrogen sulphide in the pools originates from the reduction of sulphates in anaerobic conditions; but the presence of certain organic substances (remnants of seed plants) is necessary for this process.

The quality and quantity of phytoplankton is the richest in spring. During summer it decreases in number and some species only (perhaps resistant against the poor oxygen and light conditions) remain in a small number. After some increase of it in autumn the pools are practically without any phytoplankton during winter with the exception of the periods of a thin ice, when a mass increase of phytoplankton can be found. (Auth. summ.)

3899. Schiemenz, F. 1960. UNTERSCHIED DER WANDERUNGEN DER FISCHE, INSBESONDERE DER AALE VERSCHIEDENEN REIFEGRADES, IM UNKANALISIERTEN STROM UND IM KANALISIERTEN STROM UND DIE BEDEUTUNG DER FISCHTREPPEN. Zeitschrift Für Fischerei Und Deren Hilfswissenschaften, Vol. IX, Nos. 1, 2, pp. 133-154.

When the river raises the eels and other fish of various sizes swim upstream whereas they go downstream when the water falls. The variation in the local living space depending on the level of the water appeared to be a substantial cause for the fish to travel.

So as to make possible these migrations and to get a favourable dense distribution of the fish stock for the summer, well working fish passes are necessary. This applies to fish that have been placed in the river as well as to native fish. Stocking can never be a substitute for fish passes.

Fishing experiences concerning the different density of fish stocks in reaches of the unobstructed river as well as of an adjacent "canalized" stretch show how unfavourably the density of fish stocks is affected in

summer by dams in a fish ascendance without providing excellently working fish passes and without uniformly distributed, good local protective places in the winter. The same is to be seen from the different use of equally constructed and equally located fish passes in the upper reach of an unobstructed stretch of the river or of a "canalized" stretch. (From auth. summ.)

3900. Balon, Eugeniusz. 1959. SPAWNING OF LEPOMIS GIBBOSUS (LINNE, 1758), ACCLIMATIZED IN THE BACK WATERS OF THE DANUBE AND ITS DEVELOPMENT DURING THE EMBRYONIC PERIOD. (NERES LEPOMIS GIBBOSUS (LINNE, 1758) AKLIMATIZOVANEJ V BOCNYCH VODACH DUNAJA A JEJ VYVOJ POCAS EMBRYONALNEJ PERIODY.) Vestnik Ceskoslovenske Spolecnosti Zoologicke, Vol. XXIII, No. 1, pp. 1-22.

Reproduction and embryology of L. gibbosus from the Czechoslovakian Danube River are described.

3901. Meyer-Waarden, P. F., Egon Halsband and Inge Halsband. 1960. BIBLIOGRAPHIE UBER DIE ELEKTROFISCHEREI UND IHRE GRUNDLAGEN. Archiv Fur Fischereiwissenschaft, Vol. XI, Beiheft 1, 104 pgs.

A bibliography of Electrofishing and its principles.

3902. Springer, Victor G. 1960. ICHTHYOLOGICAL SURVEYS OF THE LOWER ST. LUCIE AND INDIAN RIVERS, FLORIDA EAST COAST. Florida State Board of Conservation Marine Laboratory Maritime Base, 20 pgs.

A hydrological and ichthyological survey.

3903. Mizue, Kazuhiro, and Takehiko Mikami. 1960. STUDIES ON THE MATURATION AND THE SEASONAL CYCLE IN THE GONAD OF GIRELLA PUNCTATA. Bulletin of the Faculty of Fisheries, Nagasaki University, No. 9, pp. 18-31.

Girella punctata were collected monthly all the year round at Sasebo Bay, and authors studied the maturation and the seasonal cycle of their gonads.

1) The weight of the gonad is highest in May and the decrease and increase of the weight in this month are rapid.

2) From the variation of the weight of gonad and the observation about the histological sections of gonad, the stage of gonad maturity could be divided into three categories, that is

in the testis

1. The resting period---- June - November.
2. The preparative period for the spermatogenesis---- December - April.
3. The period of the spermatogenesis and the discharging period of the sperium---- May.

in the ovary

1. The resting period---- June - January.
2. The growing period of the oocyte----February - April.
3. The fully matured and spawning period---- May.

3) The period of the spermatogenesis and the discharging period of the spermium is very short time in comparison with other fishes, and the evidence that Girella punctata is mono-spawning have been presented from the testis.

4) There are a few seminiferous epithelium in the seminiferous tubules, and it is seen all the year on the histological sections of the testis the spermatogonia has appeared on the basement membrane for the lumen, and the spermatogonia appears newly after the discharge of the spermium and is not remnants.

5) The testis is small during eleven months between June and the following April but always the abnormal spermatogenesis has been done in the seminiferous tubules and there are many sperium in the seminiferous tubules, these sperium have no connection with the reproduction and have been digested and absorbed for the nutrient.

6) The spermatogenesis is the syncytium, namely a cyst is formed from a spermatogonia.

7) At the last stage of the spermatogenesis, the secretion is excreted in the cyst, this secretion presents the branchy condition and the many sperium have been supported and maintained at the end of these branches.

8) In the fully matured oocyte the yolk globules do not dissolve and the many oil globules in oocyte grow a large globe and it pushes out the nucleus to the animal pole.

9) In this fish the oocytes develop rapidly from February until May and can be divided into two groups in this period. One is a group of the very large oocytes which are spawned in May and the other is a group of the very small oocytes which are remaining in the ovary on and after June. Therefore it is clear that Girella punctata is mono-spawning.

10) After the spawn, it seems that the many remaining eggs have not been resolved and absorbed and they are existing in the ovary until the next spawning season.

11) In this fish the number of eggs in the ovary are very few in comparison with other fishes. By this fact it is shown that the natural death-rate in the growing times is very low. (Auth. abst.)

3904. Koga, Sigeyuki. 1960. STUDIES ON THE FLUCTUATION IN CATCH OF THE TUNA-FISHING FLEET---III. ON THE STOMACH CONTENTS OF TUNA IN THE WESTERN SOUTH PACIFIC OCEAN, ESPECIALLY IN THE FIJI AREA. Bulletin of the Faculty of Fisheries, Nagasaki University, No. 9, pp. 10-17.

Examinations were made of the stomach contents of the yellowfin and bigeye tunas caught in the western part of South Pacific Ocean in October 1958. In the Fiji area, many fish had empty stomachs. Therefore, this area seems to be poor in food organisms. Food organisms found in the stomachs amounted to about 27 kinds, including Alepisaurids, Carangids, Lepidotids, Paralepids, Ostraciontids, Balistids, Cephalopods, and Macruran shrimps. These are probably the most important as prey of tunas in the Fiji area. Coelentrates were more abundant in the Fiji area than in the region to the north of 20 S. There are differences in food habits among both fish in respect to certain kinds

of prey. Several deep sea fish, such as Paralepids and Alepisaurids, occurred in the bigeye tuna at higher frequency than in the yellowfin tuna. Others, such as Chiasmodontids and Sternoptychids occurred in the bigeye tuna, and were in the yellowfin tuna. Several surface sea fish, such as Carangids, Scrombrids, Clupeids and Ostraciontids, on the contrary, were found more abundant in the yellowfin tuna than the bigeye tuna. Others, such as Balistids, Molids, Coryphaenids and the youngs of Katsuwonids were not seen in the bigeye tuna. It will be presumed that the bigeye tuna may reside in a slightly deeper layer than the yellowfin tuna.

3905. Koga, Sigeyuki. 1960. STUDIES ON THE FLUCTUATION IN CATCH OF THE TUNA-FISHING FLEET--II. ON THE LATITUDINAL CHANGE OF THE HOOKED-RATE OF THE ALBACORE AND THE STRIPED MARLIN IN THE FIJI AREA. Bulletin of the Faculty of Fisheries, Nagasaki University, No. 9, pp. 1-9.

This study is based on the data of fishing conditions collected from the Koyo tuna-fishing fleet in the Fiji area during three months from September to November 1958, the following results are presumed as to the distribution of the albacore and the striped marlin.

In the Fiji area, the former are abundant to the south of 25°S and the latter at between 18°S and 19°S, respectively. The latitudinal change of the hooked-rate of both fish depend on the seasonal migration. In the regions to the south and to the north of 25°S respectively, tunas have a different biotope. The change of the hooked-rate of albacore in the Fiji area seemed to relate with the moon age, for instance, the hooked-rate at the spring tide was highest. So far as in the optimum temperature, lower temperature mean higher catches. (From auth. abst.)

3906. Halsband, E., and P. F. Meyer-Waarden. 1960. ENTWICKLUNG EINES ELEKTROBIOLOGISCHEN TESTES ZUR BESTIMMUNG DER ABWASSERLAST VON FLUSSEN. Archiv Für Fischereiwissenschaft, Vol. XI, No. 1, pp. 48-60.

A new electrical-biological test method was developed to test the damaging effect of wastewaters to fishes. By means of that method it is even possible to record the traces of damage in the fish, which are not yet visible, but may be felt as interior physiological disorder. This method can also be used for diluted wastewaters which do not have an immediate deathly effect to the fish which, however, disturb the biological balance in so far as the animals either leave that area or, if this is impossible, will finally suffer from such a severe damage that they die.

The method bases on the registering of the nervous-physiological changes in the fish caused by the various dilutions of wastewater.

Trout were mainly used for these tests, as this species records the lowest degree of endurance, because it reacts extremely to the wastewater poisons in the water. A comparison with the metabolism-physiological method developed earlier by Halsband shows that the values resulting from the two methods are alike.

Like the former method, the new one exactly records the various limits of damage, in particular in the region of the so-called "disturbance-threshold", where the fishes may survive for a certain time, but not for ever.

As compared with the old method, the new method has the following advantages: For experimental purposes it can be handled more easily and quickly. Under certain circumstances it can also be used for field work, and it is less expensive than the hitherto used method. (Auth. summ.)

3907. Parr, Albert E. 1960. NEGATIVE GROWTH DURING METAMORPHOSIS AND THE REGRESSION OF TAXONOMIC VARIATES UPON SIZE IN FISHES. American Museum Novitates, Number 2019, 13 pgs.

The problem of describing allometric growth during metamorphosis involving periods of shrinkage in over-all size is examined on the basis of measurements of three species of Vinciguerria published by Ahlstrom and Counts. The opinion of these authors that it is not at the present time practical to seek the ideal solution of a single equation for the entire cause of ontogenetic changes is confirmed. But it is shown that the superior resolving power of the ratio-on-size method of analysis will give a much clearer picture of the morphological changes taking place also during period of negative growth than does the size-on-size presentation. Examples are given to show how the ratio-on-size method clearly reveals inconsistencies between data and descriptions that easily develop in a concealed or inconspicuous manner by the use of the size-on-size approach. Rectilinean size-on-size regressions are in most cases incompatible with the import of the data on allometric growth in fishes. (Auth. summ.)

3908. Bagenal, T. B. 1960. THE FECUNDITY OF ENGLISH CHANNEL PLAICE. Jour. Marine Biol. Assoc., Vol. 39, No. 2, pp. 249-254; Biological Abstracts, Vol. 35, No. 18, Abst. No. 49637.

In plaice (Pleuronectes platessa L.) at Plymouth, at the western end of the Channel, the mean egg numbers for fish of a given length were similar to those of the Irish Sea and the southwest of Scotland where a fish of 37 cm would have 137 thousand eggs. The egg numbers were less (127 thousand for 37 cm) at Rye Bay which, though at the eastern end of the Channel, is an off-shoot of the North Sea population. The fecundity is however higher than in the main North Sea area. It is suggested that Rye Bay spawned fish return there to breed when adult and that they have a characteristically higher fecundity. This seems to be a general feature of the plaice that breed on the outlying spawning grounds of the North Sea. (Auth. abst.)

3909. Bagenal, T. B. 1960. THE FECUNDITY OF PLAICE FROM THE SOUTH AND WEST COASTS OF IRELAND. Jour. Marine Biol. Assoc. United Kingdom, Vol. 39, No. 2, pp. 255-262; Biological Abstracts, Vol.

35, No. 18, Abst. No. 49638. 1960.

In Plaice (Pleuronectes platessa L.) caught at Wexford in the southeast the mean egg number of 139 thousand for fish of 37 cm. is similar to that in the English Channel, Irish Sea and southwest of Scotland. From there the fecundity increases westwards along the south coast to 152 thousand at Dingle and then decreases northwards along the west coast to 132 thousand at Killybys; but in addition to these trends, the egg numbers are greater in small isolated spawning areas where the fish are scarce and in good condition. It is postulated that only fish that are able to keep in good condition and are able to produce sufficient eggs can survive in the isolated "bleak" habitats. (Auth. abst.)

3910. Sato, Ryuhei. 1959. THE USE OF PROBABILITY PAPER FOR THE GRAPHICAL ANALYSIS OF PERCENTAGE COMPOSITION OF CHUM SALMON WITH DIFFERENT SCALE CHARACTERISTICS. Tohoku Jour. Agric. Res., Vol. 10, No. 1, pp. 75-87; Biological Abstracts, Vol. 35, No. 18, Abst. No. 49647. 1960.

North Pacific salmon originating in the rivers of 3 areas are distinguishable by the distance between the circuli of the scales during the latter part of the 1st year's growth. On salmon from Asian coasts, this distance (measured in units of 0.01 mm) varies about 4.3 units; on those from most parts of Alaska, it varies about 4.3-5.3 units; on those from southern Alaska, British Columbia, and Washington, it varies about 3.2-3.6 units. By application of statistical methods to this measurement as made on numerous catches from 8 areas of the high seas, it was found that each area is populated by salmon from the nearest coast, or by a mixture of populations from different coasts in rough proportion to their nearness. (H. F. C.)

3911. Kilarski, Wincenty. 1958. THE DEVELOPMENT OF THE BLOOD VESSELS IN THE FOLDS OF THE INTESTINE OF THE SEA TROUT (SALMO TRUTTA L.) Acta Biologica Cracoviensia. Ser. Zool., Vol. 1, No. 3, pp. 69-82; Biological Abstracts, Vol. 35, No. 18, Abst. No. 50568. 1960.

The folds appear first in the epithelium of the anterior part of the intestine in embryos 19 mm in length. The development proceeds caudad; the folds are vascularized later, after connective tissue has grown into them. The details of the vascularization were investigated on fishes with blood vessels injected. (A.P.)

3912. Weisel, George F. 1960. THE OSTEOCRANIUM OF THE CATOSTOMID FISH, CATOSTOMUS MACROCHEILUS. A STUDY IN ADAPTATION AND NATURAL RELATIONSHIP. Jour. Morphol., Vol. 106, No. 1, pp. 109-129; Biological Abstracts, Vol. 35, No. 18, Abst. No. 50586. 1960

The osteocranium of a catostomid fish, C. macrocheilus, is described in detail and some pertinent comparisons made with the skulls of Carpiodes carpio (another catostomid) and Ptychocheilus oregonense (a cyprinid). The basic osteology of catostomids bears a close resemblance to that of cyprinids--implying a close relationship of the two families. Characters in which the skull differs from American cyprinids are in most instances adaptations related to the suctorial, bottom feeding habits of catostomids. Some 21 distinctive characters of catostomids are listed. The mechanism of the bones and muscles involved in suctorial feeding are also discussed. The large pharyngeal pad, which acts in filtering, is considered an important and specialized part of the feeding apparatus. The castomids should not be considered more primitive or ancestral to the cyprinids. Most of Sagemehl's (1891) criteria for catostomid primitiveness are not considered valid. Although the eventognathous fishes probably evolved from edentulous bottom feeders, the modern suckers are highly specialized and have undoubtedly diverged from the ancestral stock. (Auth. summ.)

3913. Gosline, William A. 1960. CONTRIBUTIONS TOWARD A CLASSIFICATION OF MODERN ISOSPONDYLOUS FISHES. Bull. Brit. Mus. (Nat. Hist.) Zool., Vol. 6, No. 6, pp. 325-365; Biological Abstracts, Vol. 35, No. 18, Abst. No. 51651. 1960.

The 1st section of this paper traces the caudal skeleton through the whole group. Sect. 2 deals with the classification and relationships of the salmonoid fishes, and sect. 3 with the gonorhynchoid fishes and their relationships. In this paper the salmonid and osmerid groups have been recognized as separate superfamilies, and the argentinoids have been demoted to a superfamily equivalent to them. It is here suggested that the gonorhynchids belong with the chanids, phractolaemids, kneriids, and cromeriids. Similarities between them are presented. It is not argued that Goniorhynchus, Chanos, Cromeria, Kneria, and Phractolaemur are closely related, as indeed no 2 of them are, but it seems to the author that each of the 5 is more closely related to the others than it is to anything else, and this makes it easier to tie in the group with the general clupeoid stock. In the final section a revised arrangment of modern forms, down to superfamily, is presented and its rationale discussed. A key is included. The classification is presented as a "progress report" rather than with the idea of firm conclusions.

3914. Denton, Eric. 1960. THE BUOYANCY OF MARINE ANIMALS. Sci. Amer., Vol. 203, No. 1, pp. 118-128; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51935. 1960.

Marine animals maintain their depth either by swimming or by means of flotation devices. Of the latter, the familiar gas-filled swim bladder offsets the high density of muscle and bone of many fish. It is a passive organ and therefore changes its volume as a function of depth. However, fish can slowly change the mass of gas (largely oxygen) in the bladder in order to keep the volume constant. Rapid vertical migration is impossible. Some mid-ocean fish have replaced the bladder gas with fat (0.9 density). Fat has the advantage of maintaining constant volume, but the disadvantage that much fat must be carried outside

the swim bladder. Other bathypelagic fish with no swim bladder or fat have diminished skeletons and lighter tissues (5% protein as compared to 17% of coastal fish. (H. D. F.)

3915. Aquatic Life Advisory Committee. 1960. AQUATIC LIFE WATER QUALITY CRITERIA. Jour. Water Pollution Control Fed., Vol. 32, No. 1, pp. 65-82; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51947. 1960.

This third progress report deals with the problem of establishing quality criteria for such constituents as iron, manganese, cyanides and complexed cyanides, phenolic compounds, radioactivity and detergents. Factors influencing the toxicity of such substances are discussed, as are needs for additional research. Twenty-eight literature references are appended. (I. G.)

3916. Schlichting, Harold E., Jr. 1960. THE ROLE OF WATERFOWL IN THE DISPERSAL OF ALGAE. Trans. Amer. Microsc. Soc., Vol. 79, No. 2, pp. 160-166; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51957. 1960.

A control experiment was devised whereby waterfowl were placed in a water pen in a lake where the major species of algae were known. After varying periods of time in the water, they were harnessed and hung upon a clothesline from 15 minutes to 33 hours to simulate flight. Washings of the feet, bills, and feathers, as well as faecal material were cultured in soil-water medium. Both field data and control experiments demonstrate that waterfowl can retain viable forms of algae and Protozoa both internally and externally. Those exposed to the air for less than 4 hours carried a great variety of micro-organisms while others in the air over 8 hours carried very few. Not only the biological and physical nature of the aquatic environment, but also the modes of dispersal, determine the organisms which are to be found in a given environment. Although often not considered, these modes of dispersal are important in explaining geographical distribution. (Auth. abst.)

3917. Velz, C. J., and J. J. Gannon. 1960. FORECASTING HEAT LOSS IN PONDS AND STREAMS. Jour. Water Pollution Control Fed., Vol. 32, No. 4, pp. 392-417; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51960. 1960.

The influence of thermal loads on waste assimilative capacity, aquatic life, and water reuse are discussed. Sources of thermal load and meteorological and hydrological factors influencing water temperature are mentioned, and equations are developed for computing heat balance, equilibrium temperature, and anticipated water temperature profile. The latter is found dependent on evaporation, convection, and radiation losses as well as solar radiation gain. Statistical methods for predicting variation in meteorological factors such as air temperature, wind velocity, vapor pressure, and solar radiation are presented. Field case studies for a stream and a waste water pond are presented as illustrations of the applicability of the methods developed. (I. G.)

3918. Ahlmquist, Elisabeth. 1959. OBSERVATIONS ON THE EFFECT OF ROTENONE EMULSIVES ON FISH FOOD ORGANISMS. Rept. Inst. Freshwater Res., Drottningholm 40: 146-160; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51961. 1960.

Most zooplankters, much of the epiphytic and bottom animals and some phytoplankters were killed by 0.5-0.6 p.p.m. of rotenone emulsives used in fish eradication of 3 lakes. Detoxifying elements in the biotopes protect the bottom and epiphytic forms from the usual concentrations. Many species of cladocera, rotifers, copepods, ostracods, hydrachnids, nematodes, platyhelminthes, gastrotrichs, oligochaetes, insects, gastropods, ciliates, and phytomastigophora were listed as to resistance to rotenone. (K. D. C.)

3919. Furukawa, Ichiro. 1960. STUDIES ON THE SET NET FISHERY OF THE YELLOWTAIL, SERIOLA QUINQUERADIATA, IN HYUGA NADA (I). (In Japanese with English summary) Bull. Fac. Agric. Univ. Miyazaki, Vol. 5, No. 2, pp. 128-150; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51965. 1960.

The size of the shoal varies considerably. The fish are caught from middle February to early April. Seven age-groups are recognized; of these III, IV and V age groups are predominant. Dominance of IV and V age groups makes a year of excellent yield. (Auth. summ.)

3920. Hederstrom, Hans. 1959. OBSERVATIONS ON THE AGE OF FISHES. Rept. Inst. Freshwater Res., Drottningholm 40: 161-164; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51966. 1960.

This is an English translation of a 1759 paper describing the use of rings on vertebrae of fishes to determine their ages. Validity of the method is demonstrated by the fact that the same number of rings is on both sides and on each vertebra, the number of vertebrae is the same in large and small fish of the same species but the number of rings increases with the size of the fish, the growth of the vertebrae is apparently by accretion, and the number of rings coincides with the known ages of some fish. Data are given on pike, eel, perch, codfish, and bream. Knowledge of ages of fish helps in planning their conservation. (K. D. C.)

3921. Moen, Tom. 1960. BULLHEADS BY THE MILLIONS. Iowa Conservationist, Vol. 19, No. 5, pg. 37; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51972. 1960.

Since bullheads were abundant and stunted in 1,260 acre Lost Island Lake in 1946, daily limits were removed. In the next 5 years anglers removed over a million bullheads and seines removed over 250,000 pounds of carp. The 1941 year class of bullheads which averaged 2.5 ounces at 9 years. A big 1954 year class has resulted in catch of 1/2 million in 1957 and a little over a million in 1959. (K. D. C.)

3922. Wiborg, K. F. 1960. INVESTIGATIONS ON EGGS AND LARVAE OF COMMERCIAL FISHES IN NORWEGIAN COASTAL WATERS AND OFFSHORE WATERS IN 1957-58. Fiskeridirekt. Skrifter Ser. Havunders, Vol. 12, No. 7, pp. 1-27; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51977. 1960.

During 1951 to 1958, as the spawning season progressed, the size of cod (Gadus morrhua) eggs decreased. At Skrova (Lofoten), cod eggs and larvae were scarce in 1957 but abundant in 1958. In 1958 haddock (Gadus aeglefinus) eggs and larvae occurred east of Shetland, off Vesteralen and west of the Halten Bank. Cusk (Brosmius brosme) occurred within the 400 m contour from Shetland to the north of Andenes. Saithe (Pollachius virens) larvae were taken mainly at Tampen, Stadt, on the Halten Bank, and west and south of Vesteralen. In May and June 1958, redfish (Sebastes) larvae were abundant in these same waters, especially from Andenes northward. The western limit of their occurrence in the Norwegian Sea was determined. Redfish larvae grow from a mean length of 9 mm in June to nearly 20 mm in August. (R. P. E.)

3923. Wiborg, K. F. 1960. INVESTIGATIONS ON PELAGIC FRY OF COD AND HADDOCK IN COASTAL AND OFFSHORE AREAS OF NORTHERN NORWAY IN JULY-AUGUST 1957. Fiskeridirekt. Skrifter Ser. Havunders, Vol. 12, No. 8, pp. 1-18; Biological Abstracts, Vol. 35, No. 19, Abst. No. 51978. 1960.

Cod (Gadus morrhua) were abundant near the coast, but farther offshore they were outnumbered by haddock (Gadus aeglefinus). Mean lengths of cod were 54 mm in July and 65 mm in August; those of haddock, 62 mm and 92 mm, respectively. Cod had eaten, in order of importance, copepods (mainly Calanus finmarchicus), krill, appendicularians, Limacina, cladocerans, amphipods, and the fry of redfish (Sebastes) or herring (Clupea harengus). In the stomachs of haddock, appendicularians, Limacina, and Clione were predominant, and krill, medusae and herring fry were found in smaller quantities. This difference indicates the fish select their food to a certain extent. (R. P. E.)

3924. Byczkowska-Smyk, Wanda. 1958. THE RESPIRATORY SURFACE OF THE GILLS IN TELEOSTS. II. THE RESPIRATORY SURFACE OF THE GILLS IN THE EEL (ANGUILLA ANGUILLA L.), THE LOACH (MISGURNUS FOSSILIS L.), AND THE PERCH-PIKE (LUCIOPERCA LUCIOPERCA L.). Acta Biol. Cracoviensia. Ser. Zool., Vol. 1, No. 3, pp. 83-97; Biological Abstracts, Vol. 35, No. 19, Abst. No. 53313. 1960.

The surface of blood vessels in the respiratory plates was measured, and the plates and branchial lamellae were counted on all gill arches; this permits the estimation of the respiratory surface of the gills. This surface calculated per unit body weight (cm^2/kg) is greatest in perch pike (18), smallest in the loach (5.3), and intermediate in the eel (9.9). These results are correlated with the biology of these species (motility, respiratory role of skin and intestine). (A. P.)

3925. Ganguly, D. N., Biswanath Misra, and Nikhilesh Bhattacharya. 1959. ON THE INTERRELATIONSHIPS BETWEEN TOTAL LENGTH, STANDARD LENGTH, DEPTH AND WEIGHT OF LATES CALCARIFER. Proc. Natl. Inst. Sci. India B: Biol: Sci., Vol. 25, No. 4, pp. 175-187; Biological Abstracts, Vol. 35, No. 19, Abst. No. 53315. 1960.

In this communication, an attempt has been made to analyze the interrelations between total length, standard length, depth and weight of the teleostean fish L. calcarifer. Correlation and regression analysis has been done for the original measurements and after logarithmic transformation. (Auth. abst.)

3926. Guiton, Philip. 1960. ON THE CONTROL OF BEHAVIOUR DURING THE REPRODUCTIVE CYCLE OF GASTEROSTEUS ACULEATUS. Behaviour, Vol. 15, No. 3/4, pp. 163-184; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54866. 1960.

The male three-spined stickleback in its reproductive cycle first establishes a territory, then digs in the sand until a pit is formed, collects nest material deposited in the pit, pressed and glued down firmly; bores a tunnel through the mass of material where later the female lays eggs; and becomes responsive sexually when the nest is completed. At different stages of the cycle, the nest, partly constructed or complete, was removed and the sand pit levelled to investigate how far the cyclic behavior is controlled by the changing state of the nest and how far by internal processes. When nest and pit were removed just after the fish began to build in the pit, there was a strong tendency to continue collecting nest material and a reluctance to resume digging. Later in nest-building the time was even longer before digging was resumed, and the fish continued for a while to glue in the absence of nest material and pit. In the sexual phase a new pit was not dug until after several hours, sexual responsiveness remaining high for at least an hour. The old nest was accepted if returned within 3 to 5 hours. Although the stage of construction of the nest at a given moment provided stimuli which had some effect on the behavior of the fish, changes in the threshold of each activity occurred during the course of the nesting and sexual phase. Digging was inhibited by later nesting activities which in turn were inhibited by sexual behavior. Fertilization of a clutch of eggs reduced sexual activity, and promptly facilitated digging so that the high threshold of this activity during the sexual phase appeared to be due to an inhibitory effect of sexual activity on it. Internal processes therefore seem to play a role in controlling the orderly sequence of behavior at different stages. (G. N. L.)

3927. Tugendhat, B. 1960. THE NORMAL FEEDING BEHAVIOUR OF THE THREE-SPINED STICKLEBACK (GASTEROSTEUS ACULEATUS L.). Behaviour,

Vol. 15, No. 3/4, pp. 284-318; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54882. 1960.

During the 1st few days the fish had free access to a feeding area; then the partition in their living area was closed except for one-hour feeding sessions at 1, 2 or 3 day intervals. With longer deprivation periods the number of completed feeding responses increases though the number of initiated responses does not differ, nor does the time spent performing feeding movements. As time passes in the feeding session, fewer complete feeding responses are performed. Within the general trend to decrease, a major fluctuation appears: feeding responses decrease very rapidly early in the session, then increase, and finally decrease continually to the end of the session. The characteristic of the fluctuation depends on the initial feeding rate. The dip is sharpest for the 72-hour deprevation group. Other behavior such as returns to the living area, attacks from other fish or onset of reproductive conditions is described. In analyzing feeding behavior, insensitive measures such as total time feeding, frequency of initiations or number of interruptions must be considered, for their relationship with other measures most fully describes the pattern of feeding behavior. (G. N. L.)

3928. de Oliveira, Lejeune P. H., Rubem do Nascimento, Luiza Krau, and Arnaldo Miranda. 1959. HYDROBIOLOGICAL OBSERVATION ON FISH MORTALITY IN THE LAGOON OF CAMORIM. (OBSERVACOES HIDROBIOLOGICAS SOBRE A MORTALIDADE DE PEIXES NA LAGOA DE CAMORIM.) Mem. Inst. Oswaldo Cruz, Vol. 57, No. 2, pp. 115-126; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54943. 1960.

On February 12, 1959, large-scale death of the fish of the lagoon at Camorim, Brazil, began. This was a phenomenon which had begun in 1956 and been repeated annually. The geography of the lagoon is described, with discussion of hydrography, bacteriology, etc. Analyses were made of temperature, weather, plankton, chemical constitution of the water, etc. A tentative reconstruction of the chain of events leads to the conclusion that an excess of sea water entering the lagoon around this period had caused an excessive growth of surface plankton, and when these died, the action of anaerobic bacteria produced an excess of hydrogen sulfide gas, which was the direct cause of the death of the fish. It is necessary to try to regulate the flow of sea water more effectively.

3929. Hirano, Toshiyuki, and Kenzo Sugiura. 1958. ON THE SALINITY DISTRIBUTION IN A SMALL BAY WITH RIVER DISCHARGE. (In Japanese with English summary) Bull. Tokai Reg. Fish. Res. Lab. 22, 1-15; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54954. 1960.

During February to September 1957, oceanographic surveys were carried out in Katsuragi Bay, Mie Prefecture, to study the effect of water discharge from a power dam on local fisheries. On the basis of the data obtained, the salinity distribution in the upper layer is governed by such factors as the volume of fresh water discharged, upwelling and strong vertical mixing in the vicinity of the river mouth, and a vertical mixing between the 2 layers. The following approximate equation for the salinity distribution is introduced;

$$\log\frac{S'-S}{S'} = -\frac{1}{V_0(1-\lambda(}(C_1V_0+C_2)\sigma+C_3-\lambda V_0)).$$

Here S is a mean salinity at o, S′ salinity of the offing water, σ area from the top of bay to a section line rectangular to the offing direction, V_o volume of fresh water discharged and C_1, C_2, C_3, λ are constants connecting with the vertical mixing and upwelling. In the appendix, a computation is discussed for some transient states of the mean salinity corresponding to volumes of fresh water discharged, on the assumption that the mean salinity in a small bay such as Miura Bay, Mie Prefecture, is governed by the tidal mixing and the volume of fresh water discharged. (Auth. abst.)

3930. Lellak, Jan. 1958. THE BOTTOM FAUNA OF TWO PONDS AND THEIR TEMPORARY PERIODICITY. (OSIDIENI A SEZONNI DYNAMIKA ZVIRENY DNA DVOU RYBNIKU.) (German summary) Vest. Cesk. Spol. Zool., Vol. 22, No. 3, pp. 203-231; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54967. 1960.

For 1 1/4 and 1 1/2 yrs the abundance and qualitative relationships of the macrobenthos have been studied in two ponds, that of Cernis at Ceske Budejovice in Southern Beohemia and that of Kyjsky near Prague. The following physical and chemical factors were also measured: temperature of the water; pH; alkalinity; 0_2 content of the water close to the bottom and on the surface; temperature and pH of the slime. A description is given of each location from which samples were taken. In both ponds the most abundant constituents of the bottom fauna were larvae of the families Chironomidae, Ceratopogonidae and Oligachaeta. During the course of the year a striking periodicity of abundance was noted at all the locations studied, with maxima in winter and minima in summer. This periodicity is the consequence of the changes in generations of individual members of the benthos and is probably also influenced by the feeding activity of the fish. This feeding activity was particularly striking in the littoral zone of the ponds where, for a short time, a 4-5 fold decrease occurs in the permanent fauna, the worms. Constants, accessory and accidental species of the bottom have been determined for both ponds. On the basis of this study changes and supplementation of 1st group constants are suggested for Ceckbach's (1931) classification of ponds. Most of the results obtained are arranged in tabular form. (MDS)

3931. Braginskiy, L. P. 1957. DIMENSION AND WEIGHT CHARACTERISTICS OF THE LEADING FORMS OF RESERVOIR ZOOPLANKTON. Vopr. Ikhtiol. 1957(9): 188-191; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54992. 1960.

Data are presented on the dimensions and weight

differences of various age and sex groups of about 20 species of reservoir plankton. The material was collected in 1952-1953, at Kiev Oblast' reservoirs, and was processed by the Ulomskiy method.

3932. Ingram, W. M., and A. F. Bartsch. 1960. GRAPHIC EXPRESSION OF BIOLOGICAL DATA IN WATER POLLUTION REPORTS. Jour. Water Pollution Control Fed., Vol. 32, No. 3, pg. 297; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54995. 1960.

A number of procedures are suggested for expressing results of biological surveys in more quantitative form to improve their usefulness. These include pictorial diagrams, photographs of survey samples, bar graphs, sector diagrams, line graphs, and various numerical indices which have been proposed by other investigators. (I. G.)

3933. Kajak, Z. 1960. THE REPRESENTATIVENESS OF BENTHIC SAMPLES. Bull. Acad. Polonaise Sce. Ser. Sci. Biol., Vol. 8, No. 2, pp. 67-70; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54996. 1960.

The problem of what constitutes a representative sample of benthos has never been sufficiently investigated, yet is a crucial one, especially in view of the fact that small cross-section samplers are becoming more widely used. The authors therefore selected an ecologically uniform pool with a depth of 1 m, and spotted 10 sampling points 15 m apart. A series of samples were then taken with an Ekman dredge of 225 sq. cm surface, and 2 tubular samplers with 10 and 5 sq. cm surface respectively. Average Tendipedidae populations were computed for each series of samples and the ratio: Maximum sample group average/Minimum sample group average taken as a measure of sampling variation, i.e., of sample representativeness. A value of 1.0 would therefore represent proper sampling procedure. The results indicate that small surface samplers are better suited to densely populated areas while large surface samplers are required for sparsely populated areas. In all cases a relatively small amount of material taken in a sufficient number of small and properly distributed samples is more representative than a greater amount taken in a few large samples. (MDS)

3934. Paschalski, J. 1959. OBSERVATIONS OF ENVIRONMENTAL CONDITIONS OF SMALL PONDS IN THE VICINITY OF WARSAW. (OBSERWACJE WARUNKOW SRODOWISKOWYCH DROBNYCH ZBIORNIKOW WODNYCH OKOLIC WARSZAWY.) Ekol. Polska - Ser. A., Vol. 7, No. 1, pp. 1-20; Biological Abstracts, Vol. 35, No. 20, Abst. No. 54997. 1960.

This study represents an attempt to establish methods and indicators for the description of small ponds, in order to furnish a basis for relating these indicators to sanitary problems and fish culture. Four hydrological types are distinguished: early-spring, spring, spring-summer, and spring-summer-autumn. Small temporary ponds are generally non-stratified, but less so in wintertime, when some of them exhibit thermal layering similar to that of stratified ponds. The stratification of ponds is related to depth of water; the greater the depth, the more the pond assumes a temporarily stratified character. Detailed temperature measurements make it possible to plot water isotherms, and to relate these to the isotherms of the surrounding terrain, which interacts with the pond. Chemical changes are periodic in character, depending upon the hydrological type of the pond. They are related to decomposition, and to O_2 and CO_2 content, all of which vary with the season and the water level in the pond. The ponds examined all have a low mineral content, not exceeding 122 mg/liter. They are of a carbohydrate nature when classified by Alekin's method. (MDS)

3935. Sorokin, Yu. I. 1959. ROLE OF CHEMOSYNTHESIS IN THE PRODUCTION OF ORGANIC MATTER IN RESERVOIRS. IV. FEEDING AQUATIC INVERTEBRATES ON METHANE AND HYDROGEN-OXIDIZING AUTOTROPHIC BACTERIA. Mikrobiologiia, Vol. 28, No. 6, pp. 856-860; Biological Abstracts, Vol. 35, No. 20, Abst. No. 55000. 1960.

It has been found in experiments with natural water and sediments that planktonic crustacean-scavengers (Daphnia, Bosmina, Chidorida, Diaphthomus, Ostracoda) and benthic forms (Tendipes and Oligochaeta) consume and assimilate organic body substance of the autotrophic microflora which grows by oxidizing methane and hydrogen. (Auth. summ.)

3936. Sramek-Husek, Rudolf. 1960. THE AUTUMN PLANKTON OF SEVERAL CZECHOSLOVAKIAN DAMS. (PODZIMNI PLANKTON NEKOLIKA CESKOSLOVENSKYCH PREHRAD.) (German summary) Zool. Listy, Vol. 23, No. 1, pp. 59-70; Biological Abstracts, Vol. 35, No. 20, Abst. No. 55001. 1960.

The purpose of this work was to carry out a comparison of the autumn plankton occurring in the basins of 9 dams and to determine differences in their composition. The number of samples was limited and in various places these were not taken very far from the shore, although always from the lower, stabilized half of the basin. The three-degree scale of Patalas (1954) was employed as a rough abundance scale so that incidental differences in the percentual composition of the plankton could be compared in an acceptable manner. Littoral or benthic species which were accidentally mixed in were excluded from the sociological evaluation of the real plankton community. This evaluation is presented in tabular form. Of the 13 species which were found to occur, only the species and races of the genera Daphnia and Bosmina can be considered as characteristic. As a consequence, the plankton communities of these basins may be divided into two associations: Daphnio-Bosminetum coregoni with the dolicocephalic types of Daphnia and Bosmina coregoni and an admixture of other species (Sec, Krizanovice); and Daphnio-Bosminetum longirostris with the dolicocephalic or brachycephalic types of the genus Daphnia and Bosmina longirostris and an admixture of other species (the dam basins of Vrane, Zeliv,

Knincky). Between these two well-defined associations, there exist transitions which are characterized by the absence of Daphnia species (Slapy) or Bosmina species (Hamry, Plumlov, Vranov). For this reason the author considers that both communities have only the character of associations and should be grouped together in the single association Daphnio-Bosminion. It is suggested that the normal succession in these dam basins is from the typical Daphnio-Bosminetum longirostris to typical Daphnio-Bosminetum coregoni. The frequency and abundance of several species of Cyclopidae and Cladocera indicate their practical significance as food for fishes. (MDS)

3937. Tsivoglou, E. C., M. Stein, and W. W. Towne. 1960. CONTROL OF RADIOACTIVE POLLUTION OF THE ANIMAS RIVER. Jour. Water Pollution Control Fed., Vol. 32, No. 3, pp. 262-287; Biological Abstracts, Vol. 35, No. 20, Abst, No. 55003. 1960.

Survey results are presented including uranium ore refining features, radioactivity levels in the stream, in algae and insects inhabiting the stream, river bottom muds, water treatment plant filter bed sands, milk, vegetable and crop samples obtained locally, precipitation and process effluents. Internal radiation exposure levels for several local population groups were computed. Bioassays and field studies were collected to determine what adverse effects on stream biota resulted from chemical processing effluent discharge. Remedial measures were proposed to eliminate pollution caused by both the radioactive and nonradioactive components of the uranium ore refinery effluents. (I. G.)

3938. Ben-Tuvia, Adam. 1959. THE BIOLOGY OF THE CICHLID FISHES OF LAKES TIBERIAS AND HULEH. Bull. Res. Counc. Israel Sect. B 8B(4): 153-186; Biological Abstracts, Vol. 35, No. 20, Abst. No. 57494. 1960.

Several species and subspecies of cichlid fish were investigated during the period of 1950-1951. The life histories of the following fishes from Lake Tiberias were studied: Tilapia galilaea, Tilapia nilotica, Tilapia zillii, Tristramella simonis simonis and Tristramella sacra. In Lake Huleh only Tristramella simonis intermedia was studied. The spawning season of cichlids seems to be similar for all species examined. It starts at the end of March or beginning of April and in most of the species extends until June, July, or August. In Tristramella simonis simonis it continues until the end of August. With the exception of Tilapia zillii, all the local cichlids are mouth breeders. In Tilapia galilaea, Tristramella sacra and Tristramella simonis intermedia both sexes brood their eggs while in Tilapia nilotica and Tristramella simonis simonis, brooding is by females only. The number of eggs in the ovaries was counted and the diameter of the eggs measured. An attempt was made to establish the number of fry bred by a single fish. The rate of growth is rapid in Tilapia galilaea; at the end of the first year of life the fish attains an average length of 138 mm in males and 140 mm in females. At the end of the second year the fish attains 227 mm (males) and 224 mm (females). Fishes above 330 mm in length are mostly males of five to seven years. Tilapia galilaea spawns for the first time after reaching a total length of 180 mm. A slightly slower rate of growth was found for Tilapia nilotica which also matures at the same size as Tilapia galilaea. Other species of cichlid fish grow at a much slower rate and spawn when 13-15 cm long. The relationship between length and weight of Tilapia galilaea was calculated. It was found that the condition factor K is higher in fish caught during the months January-May than during the months June-August. The food of cichlids consists mostly of phytoplankton; zooplankton and higher plants occur in small quantities. Tristramella sacra is a plankton feeder also, and not a predator as described in the previous literature on the cichlids of Lake Tiberias. A key, for the determination of cichlids in Israel was prepared, including Tristramella simonis intermedia, a form peculiar to Lake Huleh. (Auth. abst.)

3939. Miller, Robert Rush, and Carl L. Hubbs. 1960. THE SPINY-RAYED CYPRINID FISHES (PLAGOPTERINI) OF THE COLORADO RIVER SYSTEM. Misc. Publ. Mus. Zool. Univ. Michigan, 115. 1-39; Biological Abstracts, Vol. 35, No. 20, Abst. No. 57507. 1960.

This group, which was named Plagopterinae by Cope, and Medidae by some recent authors, is here treated as a tribe within the Leuciscinae. The Plagopterini embrace the monotypic genera Meda and Plagopterus, and the polytypic genus Lepidomeda. The 2 previously recognized spp. of Lepidomeda are synonymized as L. vittata Cope (= L. jarrovii Cope), with the addition of L. mollispinis, with 2 ssp. L. m. mollispinis, common in the Virgin River and its tributaries in Utah, Arizona, and Nevada; L. m. pratensis, based on specimens taken in 1938 from a wet meadow watered by Big Spring, about 1 mi. northeast of Panaca, Lincoln County, Nebraska, where ecological conditions have changed and the sp. was found to be extinct in 1959; L. albivallis, in the White River system of eastern Nevada; and L. altivelis, based on specimens taken in 1938 in Pahranagat Lake and in the outflow from Ash Spring, Nevada, and found in 1959 to have been exterminated. The entire group is confined to the Colorado River system, in which it probably arose in Pliocene time. Major differentiation probably continued through Pleistocene time, with isolation and minor speciation during the Postglacial disruptions of the drainage. The highly localized distribution of the spp. has been accentuated by stream deterioration due to human activities, as well as to the recent drought. The introduction of exotic fishes, particularly Gambusia and Cyprinus, along with agricultural operations, may have contributed to the distinction of two forms which had a very limited distribution in 1938.

3940. Moreland, J. 1960. THE OCCURRENCE OF THE PACIFIC BLUE MARLIN (MAKAIRA AMPLA

MAZARA) IN NEW ZEALAND WATERS. Rec. Dominion Mus., Vol. 3, No. 3, pp. 247-250; Biological Abstracts, Vol. 35, No. 20, Abst. No. 57510. 1960.

An average of four specimens a year have been recorded in 1956, 1957 and 1958. Biometric data on the single New Zealand specimen available are tabulated and compared with those of eastern Pacific and eastern Pacific plus western Atlantic specimens. The only differences which seem to have any possible significance are the relatively shorter prepelvic and prepectoral lengths.

3941. O'Rourke, F. J. 1960. SEROLOGICAL CRITERIA OF SPECIES. Irish Jour. Med. Sci. 1960(410): 76-80: Biological Abstracts, Vol. 35, No. 20, Abst. No. 57511. 1960.

Examples of the use of serological methods for distinguishing spp. of fish are given. Photoreflectormeter studies gave valuable quantitative information over the whole range of antigen-antibody interaction, but required relatively large quantities of antiserum. The Ouchterlony technique gave useful information on spp. relationships with smaller quantities, while the cellulose acetate immunodiffusion technique of Consden and Kohn gave even better results with microlitre quantities. For example Sebastes marinus and S. mentella could be distinguished by the latter method. (F. W.)

3942. Schwartz, F. J. 1959. RECORDS OF THE ALLEGHENY BROOK LAMPREY ICHTHYOMYZON GREELEYI HUBBS AND TRAUTMAN, FROM WEST VIRGINIA, WITH COMMENTS ON ITS OCCURRENCE WITH LAMPETRA AEPTYPERA (ABBOTT). Ohio Jour. Sci., Vol. 59, No. 4, pp. 217-220; Biological Abstracts, Vol. 35, No. 20, Abst. No. 57518. 1960.

Data on myomere and tooth counts for male and female Ichthyomyzon greeleyi and Ichthyomyzon bdellium specimens are given in tabular form. A summary comparison of measurements of the 2 spp. is also given. It is concluded that though Ichthyomyzon greeleyi and Lamptera aepyptera occur in the same stream system, aepyptera appear to inhabit smaller brooks while greeleyi occur in the larger creeks and smaller rivers. (MDS)

3943. Sokolov, V. A. 1959. THE MECHANISM FOR BUOYANCY VARIATION IN FISHES. Fiziol. Zhur. SSSR (Transl.) 45(1/2): 161-168; Biological Abstracts, Vol. 35, No. 20, Abst. No. 57519. 1960.

Stable positive buoyancy was developed in fishes (carp) as a result of a series of rises to a height of 80 cm. The discharge of gas from the swim-bladder during the period of stable buoyancy did not entail immediate change in the sign of the buoyancy. Positive buoyancy was not developed when the swim-bladder was denervated or when its nerve supply was interrupted by pentaphen methylate iodide. (Auth. concl.)

3944. Fucugauchi, Maria Elena. 1960. RADIOACTIVE MEASUREMENTS IN THE LIVING FISH. Arkiv Kemi, Vol. 15, No. 4, pp. 375-377; Biological Abstracts, Vol. 35, No. 21, Abst. No. 57886. 1960.

The radioactivity of Hyphessobrycon scholzei was determined after feeding the fish exclusively with dry blood containing Fe^{59}. In the course of 126 days a fish weighing 100 mg took up to 2 μg of iron. A 1/330 part of the iron fed was taken up by the fish. The rest and thus presumably all the food taken in was fully excreted in the course of 16-24 hours. (Auth. summ.)

3945. Schumann, George O. 1957. AN ELECTROPHORETIC SURVEY OF MULTIPLE HAEMOGLOBINS IN SOME FRESH-WATER FISHES. Rept. Inst. Freshwater Res. Drottningholm 40:176-197; Biological Abstracts, Vol. 35, No. 21, Abst. No. 58828. 1960.

Analysis of fish hemoglobin (Hb) with agar electrophoresis may give clues to taxonomic relationships. Storage of the blood may result in difficulties in separating Hb fractions; pH values also affect the separation. Fresh fish blood had a pH of 6.9 to 7.1 depending upon the species, but Esox lucius blood changed to about 7.5 when standing 10 minutes. Oxygen deficiency and starvation also affect Hb fractions. Leuciscus rutilus, L. erythrophthalmus, Perca fluviatilis, Tinca tinca and Cyprinus auratus showed only one Hb fraction. Two fractions were found in Cyprinus carassius, Abramis brama, A. blicca, Phoxinus phoxinus, Lota lota, Lucioperca sandra, Esox lucius, Acerina cernua, Cottus peocilopus, Salmo salar, S. trutta trutta, S. t. fario, and Oncorhynchus keta. Of species tested so far only Salmonidae have 3 Hb fractions and 9 of the 13 forms tested have 3. S. trutta lacustris was found to have 3 while two other subspecies had only 2. (K. D. C.)

3946. Ananichev, A. V. 1959. DIGESTIVE ENZYMES OF FISH AND SEASONAL CHANGES IN THEIR ACTIVITY. Biokhimiia (Transl.), Vol. 24, No. 6, pp. 952-958; Biological Abstracts, Vol. 35, No. 21, Abst. No. 59551. 1960.

Seasonal differences were found in the activities of pepsin, trypsin, amylase and lipase of the burbot, pike, perch and bream, from the Rybinsk reservoir. Maximal activities were found for pepsin, trypsin and lipase to coincide with periods of intensive food intake; during the winter months for burbot, and during the summer months for pike, perch and bream. The amylase activity of all three species of fish was maximal during the periods of almost total abstention from food, and of preparation for spawning. Tryptic activity remained high during these same periods. The Michaelis constants of the digestive enzymes of fish, and their temperature dependences, differ very considerably from those of homeotherms. Their temperature optima tend to fall progressively with increasing duration of incubation. Their pH optima fall within the same ranges as for the corresponding enzymes of homeotherms. Seasonal variations in the activities of the enzymes are due to differences in their rates of production. (Auth. summ.)

3947. Grodzinski, Z. 1959. THE DEVELOPMENT OF THE LYMPH HEART IN SEA-TROUT SALMO TRUTTA L. Bull. Acad. Polonaise Sci. Ser. Sci. Biol., Vol. 7, No. 8, pp. 305-311; Biological Abstracts, Vol. 35, No. 21, Abst. No. 59727. 1960.

The origin of the lymph system has long been under dispute, one school maintaining that it develops spontaneously from transformed mesenchyme cells, and the other that it descends from the venous endothelium. With a view to settling this dispute, the author investigated the development of the lymph heart in sea-trout embryos, the vessels of which were injected with India ink. The appearance of the blood vessels in the region was observed for living specimens in the same developmental stages. The author describes the results, which indicate that the lumph heart is a distended and rebuilt portion of the caudal vein. First there is a doubling of the caudal vein situated caudally to the last dorsal segmental vessel. It then grows elliptically, and a lateral vessel is formed from the extended vein. Eventually lymphatics develop in the caudal fin, valves develop, the heart begins to contract rhythmically and expels the blood corpuscles, which then had filled it. (MDS)

3948. Wald, George. 1960. THE SIGNIFICANCE OF VERTEBRATE METAMORPHOSIS. Circulation 21 (5 Pt. 2): 916-938; Biological Abstracts, Vol. 35, No. 21, Abst. No. 59752. 1960.

This paper examines the biochemical changes that accompany metamosphosis in vertebrates, as correlated with the anatomical and ecological changes, and with phylogeny. The thread that binds together the argument is based upon the chemistry of visual systems; but correlated changes are found in the hemoglobin pattern, N excretion, plasma proteins, and blood osmotic pressures. Fresh water and marine fishes divide in the chemistry of their visual systems, the former using vitamin A_2, the latter vitamin A_1 in vision. Euryhaline fishes are intermediate in this regard, as in their ecology; the environment in which such a fish spawns is the primary determinant of its visual chemistry. At sexual maturity, certain euryhaline fishes undergo a 2d metamorphosis to prepare them for their return to the environment in which they were spawned. This 2d metamorphosis involves not only anatomical changes but biochemical changes which tend to reverse those of the 1st metamorphosis. (Auth)

3949. Yeh, Ye-Tsu. 1959. A PRELIMINARY REPORT ON THE OXYGEN CONSUMPTION, ENERGY REQUIREMENT, ASPHYXIATION POINT AND RESPIRATORY QUOTIENT OF THE FISH FRY AND YOUNG FISH. (In Chinese with English summ.) Acta Zool. Sinica 11(2): 117-137; Biological Abstracts, Vol. 35, No. 21, Abst. No. 59755. 1960.

Among our important cultivated fishes, the O_2 consumption and energy requirement of Hypophthalmicthys molitrix rank the highest, those of Aristichthys nobilis, Mylopharyngodon piceus and Ctenopharyngodon idellus are the next while those of Cyprinus carpio and Carassius uaratus are the lowest. The O_2 consumption and energy requirements of the same species decrease relatively with the increase in age and body weight. But within the unit time (hour), O_2 consumption and energy requirements of individual fish increase accordingly with the increase in age and body weight. These changes are related closely to the changes in stages of development. The environment also influences the O_2 consumption and energy requirement of fishes. For instance, within the normal range of temperature, the rate of O_2 consumption and energy requirement increases with the rising of temperature. This phenomenon is more conspicuous in the lower ranges of water temperature. The concentration of dissolved or free CO_2 within certain ranges has little influence on the O_2 consumption and energy requirement of adult fish. In fish fry, as the regulatory mechanism of the central nervous system has not fully developed the rate of O_2 consumption is influenced by the changes of O_2 pressure of the environment. As it is in other animals, there are diurnal variations in the O_2 consumption and energy requirement of fishes. These changes are, as a rule, free from daylight influence of the experimental environment. There are inter- and intra-species variations in asphyxiation point and respiratory frequency of fishes. Among our important cultivated fishes, the asphyxiation point of Mylopharyngodon piceus is 0.89--0.63, ranking the highest, that for Hypophthalmicthys molitrix (0.72--0.34), Aristichthys nobilis (0.68--0.34), Ctenopharyngodon idellus (0.51--0.30) is the next, while that for Cyprinus carpio (0.34--0.30) and Carassius auratus (0.13--0.11) is the lowest. The asphyxiation point of diseased and wild fishes is generally higher than that of healthy cultivated ones. Within the normal ranges of temperature, the respiration frequency also increases with the rising pf temperature. This phenomenon is more conspicuous in the cold-water fishes or in the lower ranges of temperature. Again the respiration frequency in fishes increases as dissolved O_2 in water decreases. Therefore, to a certain extent, the sudden increase of respiration frequency forecasts the asphyxiation of the fish. (From auth. abst.)

3950. Hilsenhoff, William L. 1960. TREATING WATER AREAS WITH GRANULAR INSECTICIDES. Mosquito News, Vol. 20, No. 2, pp. 187-188; Biological Abstracts, Vol. 35, No. 21, Abst. No. 61145. 1960.

A method for the treatment of water areas with granular insecticide has been developed. Water is pumped through a Venturi type filter pump, and insecticide granules, entering the modified side arm of the pump by gravity from a reservoir, mix with the water, The water containing the insecticide granules is sprayed onto the area to be treated. (Author)

3951. Oliva, Ota. 1958. ON THE SEA LAMPREY (PETROMYZON MARINUS L.) FROM THE ELBE RIVER NEAR DECIN. (O NALEZU MIHULE MORSKE (PETROMYZON MARINUS L.) V LABI U DECINA.) (English and Russian summ.) Vest.

Cesk Spol. Zool., Vol. 22, No. 2, pp. 111-112; Biological Abstracts, Vol. 35, No. 21, Abst. No. 61319. 1960.

The author refers to one specimen of sea lamprey which he received from the museum of the city of Decin in Northern Bohemia. The lamprey was probably caught in the year 1912 in the Elbe River near the city of Decin. Finds of sea lampreys are very rare in the Czechoslovakian literature, and this specimen is most likely the only find in Bohemia during this century. The specimen examined was a female, total length 704 mm, weight 680 g (preserved in a solution of formalin). The back and sides are covered with white and dark spots. (MDS)

3952. Sukhoverkhov, F. M., and A. S. Pisarenkova. 1960. THE ACCLIMATIZATION OF ASIATIC FISH IN EUROPE. (K PROBLEME AKKLIMATIZATSII RYB V EVROPE.) (Czech and German Summ.) Zool. Listy, Vol. 23, No. 1, pp. 71-82; Biological Abstracts, Vol. 35, No. 21, Abst. No. 61324. 1960.

On the basis of detailed investigations into the oxygen content of various Russian reservoirs and the weight changes observed in Ctenopharyngodon idella and Hypophthalmichthys molitrix, the authors conclude that these fish are quite capable of spending the winter in the European regions of the USSR, losing about 4-11% of their body weight compared to a loss of only about 0.5% of the body weight when wintering in the Krasnodar region. The growth of these fish is better in European Russia than in their original homeland, Southern Russia providing the best environment. The rate of growth is determined by the temperature and the available food supply, including Chlorophyceae and Diatomaceae. Most of the original parasites were lost during the acclimatization period, the main enemy of C. idella being ichthyophthiriasis. Sexual maturity also develops in the European environment, but requires about 7 rather than 5 years. The authors conclude by mentioning that several other spp. of Siberian fish have also been acclimatized to European conditions. (MDS)

3953. Westlake, D. F. 1959. THE EFFECTS OF ORGANISMS ON POLLUTION. Proc. Linn. Soc. Lond. 170(2): 171-172; Biological Abstracts, Vol. 35, No. 22, Abst. No. 61879. 1960.

Water pollution affects aquatic organisms, but conversely the organisms also produce change. In badly polluted water the populations of tubificid worms, Asellus, and Chironomus larvae are very high and Edwards calculated that the Chironomus larvae alone could lower the oxygen concentration in the river by over 1.0 p.p.m. per mile at 15°C. Dense plant populations have been reported to cause great diurnal and seasonal changes in the oxygen content of rivers. In one mildly polluted river the plant population was 1.5±0.2 kg. fresh weight of weed per square metre (mostly Potamogeton pectinatus). Calculations suggested that the mean change for a whole average day would probably be about + 0.6 p.p.m. of oxygen during July. (L.I.S.)

3954. Francois, Y. 1959. THE COMPARATIVE ANATOMY AND EVOLUTION OF THE DORSAL FIN. (LA NAGEOIRE DORSALE ANATOMIE COMPAREE ET EVOLUTION.) Annee Biol., Vol. 35, No. 3/4, pp. 81-113; Biological Abstracts, Vol. 35, No. 22, Abst. No. 63251. 1960.

Considered are the dorsal fin system of teleosts from the standpoint of fin-rays, endoskeletal structure, the extension of the dorsal fin and its relation to metamerism. Sections on the holosteans, chondrosteans, crossopterygians, dipnol, selacheans, pladoderms, and agnathostomes follow. The review shows great variety in the formation of the dorsal fin throughout the preceding fish groups. The older view of seeking to derive known structural forms from a dipnolan ancestry such as Ceratodus, or from a selachian one with multiradiate condition of the fin such as in Scyllium, has given way to the idea that origin cannot be directly traced to a particular type. In general 3 fundamental dorsal fin types may be considered as correspondent to three large groups of lower vertebrates: the chondrichthyan, the actinopterygian, and the crossopterygian. A dorsal primitive fin structure is difficult to visualize. In any event the classical concept is now seemingly a "myth without foundation." (C.E.P.)

3955. Wolf, Ken, S. F. Snieszko, C. E. Dunbar, and E. Pyle. 1960. THE VIRUS NATURE OF INFECTIOUS PANCREATIC NECROSIS IN TROUT. Proc. Soc. Exptl. Biol. and Med., Vol. 104, No. 1, pp. 105-108; Biological Abstracts, Vol. 35, No. 22, Abst. No. 63556. 1960.

A filterable, heat-labile, glyceroltolerant agent was isolated from trout with infectious pancreatic necrosis. Mammalian cell cultures and strains proved refractory, but the agent was cytopathic for trout tissue culture. Eighth and ninth tissue culture passage materials were fed to susceptible trout. The usual clinical symptoms followed, and the disease was confirmed by histological section. (Auth. abst.)

3956. McAllister, D. E. 1960. G. WHEATLANDI, NEW SPECIES OF FISH FOR THE PROVINCE OF QUEBEC. (LE GASTEROSTEUS WHEATLANDI, NOUVELLE ESPECE DE POISSON POUR LA PROVINCE DE QUEBEC.) Naturaliste Canadien, Vol. 87, No. 5, pp. 117-118; Biological Abstracts, Vol. 35, No. 22, Abst. No. 65054. 1960.

New distribution records of spp. from Gethsemane R., Baie de Chaleurs, Belle Anse (E. Gaspe Co.), Cacouna, l'Ile-aux-Coudres, Les Eboulements, Chateau Richer, l'Ile-Verte, St. Andre (Kamouraska Co.), Kamouraska, and Quelle R. (G.R.B.)

3957. Neururer, Hans, and Kurt Slanina. 1960. CHEMICAL CONTROL OF UNDESIRABLE POND PLANTS WITH SPECIAL ATTENTION TO THE TOXICITY OF HERBICIDES TO FISH. (CHEMISCHE BERUCKSICHTIGUNG UNERWUNSCHTER TEICHPFLANZEN MIT BESONDERER BERUCKSICHTIGUNG DER FISCHTOXIZITAT VON HERBIZIDEN. Pflanzenschutzber, Vol. 24, No. 8/10, pp. 139-162; Biological Abstracts, Vol. 35, No. 23, Abst. No. 65635. 1960.

Investigations on the control of noxious water

weeds carried out in the laboratory and in the open are reported. In the laboratory the approximate dose of some herbicides which can be tolerated by Phoxinus laevis, Gammarus pulex, Daphnia pulex, and some plant species was determined, as well as the dose which is toxic. By comparing the dose required to control weeds with the dose which can be tolerated by fishes and their food animals, the security quotient is derived as the measure of the aptitude of a chemical: S = fD/pD (S = security quotient, pD=dose to control weeds, fD = dose tolerated by fishes and their food animals). The security quotient must be large since laboratory studies cannot always be duplicated in the open. It is recommended that only such chemicals be applied that have a security quotient greater than 20 until further questions can be solved. Of the products tested, two exceeded this value: Simazin (2-chloro-4, 6-bis-(ethylamino)-s-triazin), S=33; Cutralin (Aminotriazol + trichloro-acetic acid + 2, 4-dichlorophenoxyacetic acid), S = 260. Pond weeds were successfully controlled using 18 mg Cutralin per liter. (Authors)

3958. Brouardel, Jean, and Emile Rinck. 1958. APPARATUS EMPLOYED IN THE MEDITERRANEAN FOR THE STUDY OF THE PRODUCTION OF ORGANIC MATERIAL. (APPAREILLAGE EMPLOYE EN MEDITERRANEE POUR L'ETUDE DE LA PRODUCTION DE MATIERE ORGANIQUE.) Jour. Conseil Internatl. Explor. Mer, Vol. 24, No. 1, pp. 10-16; Biological Abstracts, Vol. 35, No. 23, Abst. No. 65643. 1960.

Modifications of the Steeman Nielsen C^{14} method are described. Special plexiglass samplers operating in pairs were devised to facilitate laboratory analysis. (N. W. R.)

3959. Butcher, R. W. 1959. SYMPOSIUM ON WATER POLLUTION. Proc. Linn. Soc. Lond., Vol. 170, No. 2, pp. 159-165; Biological Abstracts, Vol. 35, No. 23, Abst. No. 65644. 1960.

Postulating river pollution to be the emptying into a river of substances which disturb the natural biological balance to a marked degree, the assessment and prevention of pollution is seen primarily as a biological problem. The method was to make a general collection of the fauna on weeds and in the mud and a quantitative estimation of the algae growing on glass slides submerged for three weeks. With gross organic pollution the water is deoxygenated, the river bed is covered with a film of organic silt fermenting anaerobically, the animal community comprises tubificid worms and Chironomus larvae, while the plants form "sewage fungus" of which the dominant species is usually the schizomycete Sphaerotilus natans. With progressive decomposition of the organic matter the isopod Asellus appears, followed by molluscs and finally caddis fly larvae, amphipods, etc. The first algae to appear are Nitzschia palea, Comphonema parvulum, Stigeoclonium tenue, then the two diatoms replace the Stigeoclonium and occur in abnormally large numbers compared with a clean river, and finally in the purer water the commonest organisms are Cocconeis placentula, Chamaesiphon and Ulvella. These intermediate and final communities are of similar composition whatever the nature of the original community in the river. With this biological sequence the state of pollution is readily estimated and several cases are described to illustrate its application in studying the effects of industrial discharges into rivers. (L. I. S.)

3960. Hitchcock, Stephen W. 1960. EFFECTS OF AN AERIAL DDT SPRAY ON AQUATIC INSECTS IN CONNECTICUT. Jour. Econ. Ent., Vol. 53, No. 4, pp. 608-611; Biological Abstracts, Vol. 35, No. 23, Abstract No. 68582. 1960.

Ten foot-square samples were taken at each of five streams before and after a woodland DDT spray was applied to check the qualitative loss of insect genera. Disregarding those genera that disappeared from the streams by reason of adult emergence only two insects disappeared from all the treated streams. However, individual streams varied considerably in their individual losses, ranging up to a possible loss of 42. 8% of the genera in one stream. (Auth.)

3961. Stewart, L. 1960. AN INVESTIGATION INTO THE EFFECTS OF ELECTRIC FISHING EQUIPMENT ON SALMON AND SEA TROUT WITHIN THE AREA OF THE LANCASHIRE RIVER BOARD. Lancaster, Lancashire River Board. 21 pgs.

It is now quite well known that each type of electric fishing machine has certain advantages, some types more than others. No one type, however, can be recommended as meeting all requirements, without some modification. No single unit is suitable for waters of all areas and depths and efficiency can only be obtained if a local electric field is capable of being produced in the river or pool, the area of such field depending upon the temperature and resistivity of the water.

The most important factor which came to light, from the experiments related here, is that the voltage loadings applied to rivers containing large salmon and sea trout must be extremely low, when measured in terms of voltage per inch of fish. Otherwise, it is likely that harm will result.

As a guide to a safe voltage gradient per inch of fish, it is suggested that a factor of three be divided by the length of fish to be electrically stunned, the resultant figure behind the approximate voltage required per inch of fish to give safe working result. (From auth. concl.)

3962. Carlander, Kenneth D., Richard R. Whitney, Everett B. Speaker, and Kenneth Madden. 1960. EVALUATION OF WALLEYE FRY STOCKING IN CLEAR LAKE, IOWA, BY ALTERNATE-YEAR PLANTING. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 249-254.

Stocking of 5, 000 to 9, 500 walleye fry, Stizostedion vitreum vitreum (Mitchill), per acre in Clear Lake, Iowa, in the even-numbered years resulted in larger numbers of walleyes in those year classes than in the odd-numbered year classes (1949 to 1957) when no

walleye fry were stocked. This conclusion was reached because (1) more walleye fingerlings were collected by seining beach areas in years of stocking than in years of no stocking; (2) age distribution of walleyes collected in experimental gill nets each year, 1947 to 1958, indicated that the even-numbered year classes were more abundant than the odd-numbered year classes; (3) catch of walleyes in even-numbered year classes, computed for an equal amount of experimental gill-netting, outnumbered those in year classes, when there was no fry stocking by 3 to 1 during the first 6 years of the life of the fish; and (4) estimates of population by tagging and recovery techniques indicated that the 1950 year class was much greater than the 1949 year class. (Auth. abst.)

3963. Beyerle, George B., and Edwin L. Cooper. 1960. GROWTH OF BROWN TROUT IN SELECTED PENNSYLVANIA STREAMS. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 255-262.

Samples of age-groups O and I fish from wild populations of brown trout (Salmo trutta Linnaeus) indicated a similarity in the periodicity of growth in three streams in Pennsylvania. Growth in length of trout of both age groups followed a similar pattern in the three streams, with the most rapid growth occurring in the spring and very little growth occurring in the winter months. Estimates of the mean total length at the end of two complete growing seasons were 7.0, 7.8, and 8.5 inches, respectively, for the three streams. Values of the exponent b of the customary length-weight formula were similar among the three populations, varying from 2.94 to 3.01. Annual variations in condition of the trout were also similar in the three streams. An increase in condition in the spring coincided with an increase in growth rate; a drop in condition in fall and winter was accompanied by slower growth. The trout population in Spruce Creek had the highest average condition throughout the year. This population also had a significantly greater mean length than the other two at the end of the 2-year period. The specific growth rate in weight of age-group O trout in Spruce Creek declined from a high of 5.6 percent of their body weight per day in early June to negative values in November and December. During the second summer of life the specific growth rate increased to a high of 3.1 percent per day in April and subsequently decreased to a very low value in fall and winter. (Auth. abst.)

3964. Lennon, Robert E., and Phillip S. Parker. 1960. THE STONEROLLER, CAMPOSTOMA ANOMALUM (RAFINESQUE), IN GREAT SMOKY MOUNTAINS NATIONAL PARK. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 263-270.

The stoneroller (Campostoma anomalum) is one of the more important fish in Great Smoky Mountains National Park because of its abundance and habits. Although esteemed locally as a food and a bait fish, the stoneroller is exploited but little since the fishing regulations which govern the utilization of game fishes afford it a large measure of protection. Distribution is controlled by gradient with an upper limit of 4.4 percent. Stonerollers limit reproduction of rainbow trout (Salmo gairdneri) by destroying trout redds. Artificial reduction of stoneroller populations is not considered a necessary management procedure. (Auth. abst.)

3965. Garlick, Lewis R., and Jack E. Hemphill. 1960. THE DEVELOPMENT OF SPORT FISHERY RESOURCES ON INDIAN LANDS IN THE SOUTHWEST. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 271-273.

Waters on Indian lands have been generally unavailable to the public for sport fishing in the Southwest. The Indian tribes that have jurisdiction over tribal lands and waters are recognizing the economic value and employment potential to be derived from sport fishery resources. Programs are now being formulated in cooperation with the Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service to develop these fisheries. Tribal funds are being used to develop fishing waters and facilities for the use of the public. Some problems encountered in developing sport fisheries on Indian lands are discussed. A successful program on the Fort Apache Indian Reservation is described. (Auth. abst.)

3966. Webster, Dwight A., William A. Lund, Richard W. Wahl, and William D. Youngs. 1960. OBSERVED AND CALCULATED LENGTHS OF LAKE TROUT (SALVELINUS NAMAYCUSH) IN CAYUGA LAKE, NEW YORK. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 274-279.

Back-calculated lengths of lake trout (Salvelinus namaycush) in Cayuga Lake, New York were compared with empirical values. The body-scale relationship was sigmoid over a range of fish lengths of 6 to 26 inches; the method of back-calculation involved preparation of a body-scale ruler adapted for use on a conventional direct proportion calculating device. When compared graphically, calculated and observed mean lengths (through age VII) were in excellent agreement. Calculated data showed a significantly lower variance than observed. (Auth. abst.)

3967. Shetter, David S. 1960. THE RELATIVE EFFECTIVENESS OF SALMON EGGS AND EARTHWORMS AS BAIT FOR TROUT IN THE STURGEON RIVER, MICHIGAN. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 280-286.

The relative effectiveness of salmon eggs and large earthworms as bait for trout, and the efficiency of chumming with either lure, were tested by experimental fishing in the Sturgeon River (Cheboygan County), Michigan, on 35 different days during 1957 and 1958. Four anglers fished in pairs in any series of test days, using standardized terminal tackle under a systematic pattern of lure and method. Ten individuals fished 778 hours and caught 506 rainbow trout, 73 brown trout, and 12 brook trout. Logarithmic

transformations were applied to the individual catch-per-hour data, followed by a factorial analysis of variance. Large (10-24 inches) rainbow trout in the summer of 1958 were caught 3.8 times faster on salmon eggs than on worms; smaller trout were caught 2 to 9 times faster on eggs than on worms; and chumming did not increase the efficiency of either lure for any size of fish. The differences noted between average total lengths of egg- and worm-caught trout were not statistically significant. Eggs caught a significantly larger fraction of small rainbow trout than did worms, but both lures took about the same proportion of larger rainbow trout. The estimated age distribution of rainbow trout caught is presented. (Auth. abst.)

3968. Waters, Thomas F. 1960. THE DEVELOPMENT OF POPULATION ESTIMATE PROCEDURES IN SMALL TROUT LAKES. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 287-294.

The development of suitable procedures of mark-and-capture population estimation was undertaken on two small trout lakes. Effort was primarily applied toward evaluation of the assumption of equal vulnerability between marked and unmarked fish. Using traps and angling, four basic procedures were employed and the resulting estimates compared. Estimates obtained by angling and recapture procedures were judged too high, apparently because marked fish had acquired a hook resistance. Estimates from a trap and recapture by trap procedure were too low when hoop nets were employed, but when hardware cloth traps were used the estimates were too high. Estimates obtained by procedures which involved making the recaptures by a different method, trap and recapture by angling and angling and recapture by trap, were considered best since they were compatible with known numbers present and numbers previously planted and agreed well with each other. (Auth. abst.)

3969. Moody, Harold L., 1960. RECAPTURES OF ADULT LARGEMOUTH BASS FROM THE ST. JOHNS RIVER, FLORIDA. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 295-300.

Four thousand two hundred and ninety-eight native largemouth bass were tagged and released in Lake George, a wide area of the St. Johns River, Florida, near its mid-section. Recoveries of 333 fish were made with nets in Lake George during the period of release, and 189 were reported by anglers from the river system during 7 years. Sport fishermen returned more marked fish in late winter and spring than during other seasons. It is suggested that the Lake George largemouth bass population may consist of a resident segment with restricted ranges, and of a mobile group which tends to move more freely through the St. Johns River. More large bass than small bass were recaptured from points where they were released. The percentages recaptured in Lake George away from their points of release were approximately equal for both size groups. A larger percentage of recoveries from areas in which fish were released was found during winter than during fall months. Within the first year after release at least 30 percent of the anglers' returns were made from areas beyond Lake George. Recoveries by sport fishermen were made as far as 60 miles upstream and 123 miles downstream from the points of release. Downstream returns included recoveries from highly saline waters near the river mouth. (Auth. abst.)

3970. Wood, E. M., W. T. Yasutake, J. E. Halver, and A. N. Woodall. 1960. CHEMICAL AND HISTOLOGICAL STUDIES OF WILD AND HATCHERY SALMON IN FRESH WATER. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 301-307.

In a study of coho salmon (Oncorhynchus kisutch), the gross chemical and histological changes occurring over a 14-month period spent in fresh water were determined. The determinations were made at 3-month intervals on: 1) hatchery-reared fish, 2) fish hatchery-reared for 3, 6, 9, and 12 months and then planted in a controlled stream for the remainder of the period; and 3) an indigenous group of wild fish in this stream. Wild fish showed high incidence of tissue damage from spinose hairs of the moth larva, Halisidota argentata. Hatchery fish were similarly affected with the severity and incidence of lesions varying directly with the time of exposure of the larvae in the wild environment. Both groups of fish were heavily parasitized by sporozoan organisms in the kidney and spinal cord. Kidney disease appeared in both wild and planted hatchery fish. The gross chemical composition of hatchery fish transformed rapidly after planting to that of the wild fish. Although the initial rate of fat loss is essentially constant for all hatchery groups after planting, fish that were hatchery reared for 9 to 12 months did not complete the transformation to the wild-type body composition by the time of downstream migration at 14 months. (Auth. abst.)

3971. Budd, John C. 1960. SURVIVAL AND GROWTH OF TAGGED LAKE TROUT IN SOUTH BAY, LAKE HURON. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 308-309.

Early survival of the planted fish was good, but as size increased, survival decreased. Growth of the tagged fish was normal with no indication that the tagging had adversely affected it. While it is recognized that no prediction of the future success of large scale plantings can be made from the limited experiment reported here, there is indication that present conditions favor early survival of introduced yearling stock. (From auth. summ.)

3972. Ross, A. John, Phyllis R. Mordstrom, Jack E. Bailey, and John R. Heaton. 1960. A BACTERIAL DISEASE OF YELLOW PERCH (PERCA FLAVESCENS). Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 310-312.

The bacterium discussed in the present paper is believed to be previously undescribed. Although reports of bacterial diseases of perch are practically

non-existent in the literature, Plehn (1924) reported several epizootics of Perca sp. occurring in Lake Geneva which she called "typhoid disease of perch." Although the causative organism itself was insufficiently described to compare with the organism in the present study, there were several striking similarities between the disease in Lake Geneva and the recent epizootic in Lake Dailey. (From auth. disc.)

3973. Chakravarti, Diptiman, and Timothy Joyner. 1960. POTASSIUM AS AN INDEX OF NATURALLY OCCURRING RADIOACTIVITY IN TUNA MUSCLE. Transactions of the American Fisheries Society, Vol. 89, No. 3, pp. 312-314.

The mean potassium content of the tuna muscle examined was found to be 2.3 milligrams per gram of wet tissue, and the mean expected radioactivity from the naturally occurring potassium isotope K^{40} was calculated to be 4.2 disintegrations per minute per gram of wet tissue. The levels of potassium in light and dark muscle samples were not significantly different. (Auth. summ.)

3974. Oliver, D. R. 1960. THE MACROSCOPIC BOTTOM FAUNA OF LAC LA RONGE, SASKATCHEWAN. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp. 607-624.

In the summers 1948 to 1953 (except 1951) 796 quantitative dredge samples were taken in the main lake and 172 in Hunter Bay. The 1948 and 1949 populations of the main lake were significantly higher than the 1952 and 1953 populations. No significant yearly difference occurred in Hunter Bay. The amphipods (mainly Pontoporeia affinis) predominated in the oligotrophic Hunter Bay which had 2192 organisms per square metre and dry weight of 6.4 lb per acre. The chironomid larvae (mainly Chironomus anthracinus) predominated in the mesotrophic main lake which had 742 organisms per square metre (7.9 lb/acre, 8/8 kg/ha). The depth distribution of the main groups are given. Correlation of depth with numbers was shown. Numbers in the main lake showed spring and fall maxima, with a summer minimum. The yearly variation was greatest in the chironomid larvae. The ooze type in the upper littoral had the greatest number of organisms. An annotated species list of some groups is given. (Auth. abst.)

3975. Hewson, L. C. 1960. A HISTORY OF THE LAKE WINNIPEG FISHERY FOR WHITEFISH, COREGONUS CLUPEAFORMIS, WITH SOME REFERENCE TO ITS ECONOMICS. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp. 625-639.

The evolution of the Lake Winnipeg whitefish fishery with respect to location, catch, boats and gear is traced from 1883 to 1958. Economic factors affecting fishing techniques and which have implications in management are indicated. (Auth. abst.)

3976. Lawler, G. H. 1960. A MUTANT PIKE, ESOX LUCIUS. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp. 647-654.

A striking variant of the northern pike, Esox lucius, differing from the normal pike in colour and in some morphological measurements, comprised 0.2% of the pike population of Heming Lake, Manitoba. (Auth. abst.)

3977. McDonald, J. 1960. THE BEHAVIOUR OF PACIFIC SALMON FRY DURING THEIR DOWNSTREAM MIGRATION TO FRESHWATER AND SALTWATER NURSERY AREAS. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp 655-676.

The downstream migration of sockeye, coho, pink and chum salmon fry is initially nocturnal and appears to be regulated quite precisely by changes in light intensity. Downstream movement is seen to arise from a displacement by the current when firm visual contact with fixed objects in the stream is lost. Once the migration is under way the distribution of the fry varies. The lateral distribution of pink and sockeye, but not chum and coho, was closely and positively related to current speed, above a threshold of 1.3 ft/sec (0.4 m/sec.). Pink fry were found to be distributed throughout the total depth of water but greatest catches were made at intermediate depths. The negative response of fry to light appears to change after exposure to it, and pink and chum fry were found to extend their movements into and throughout the daylight hours where the migration route was lengthy. Feeding and schooling activity is probably associated with this change in response to light. Both pink and chum fry were observed to school only near the end of their seaward movement. Pink fry were found to feed to some extent in the natal areas but to a greater extent as the sea was approached. (Auth. abst.)

3978. Smith, M. W. 1960. AN ATTEMPT TO IMPROVE TROUT FISHING IN A NEW BRUNSWICK LAKE BY DEFERMENT OF OPENING OF ANGLING SEASON. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp. 677-685.

Deferment of opening of angling season for brook trout at Crecy Lake, New Brunswick, from April to June 1, resulted in much improved angling in early summer. The improvement was relatively minor in July and August. Earlier removal of stock and adverse effects of high water temperature on feeding of trout conditioned the poorer midsummer angling. There was a lower survival of planted trout to anglers' catches with the late opening. (Auth. abst.)

3979. Nicholls, C. F., and E. A. Doxtator. 1960. AN AQUARIUM FOR MAINTAINING CONSTANT PREY POPULATION DENSITIES IN STUDIES OF PREDATOR-PREY INTERACTIONS. Journal of the Fisheries Research Board of Canada, Vol. 17, No. 5, pp. 687-688.

An adjustable aquarium is described and illustrated. The apparatus provides a means of regulating the effective volume of a tank in relation to variations in prey population. (Auth. abst.)

3980. Renfro, William C. 1960. SALINITY RELA-

TIONS ON SOME FISHES IN THE ARANSAS RIVER, TEXAS. Tulane Studies in Zoology, Vol. 9, No. 3, pp. 83-91.

The objective of the study was to note the occurrence of fishes in varying salinities. Salinity tolerance as here used is construed to be the capacity of fish to endure specific levels of dissolved salts. Twenty-six species belonging to eight orders and 16 families were collected. Nine species (Dorosoma petenense, Notropis lutrensis, Ictalurus furcatus, Gambusia affinis, Micropterus salmoides, Chaenobryttus gulosus, Lepomis megalotis, Lepomis macrochirus, and Cichlasoma cyanoguttatum) are fresh-water fishes, i. e., they are found in fresh water and occur in salt waters only occasionally or in reduced numbers. Five of these species were found in a salinity of 17.4 °/oo, which indicates that they have at least temporary tolerance to this salinity.

When salinity is lowered these fishes venture into the lower reaches of the river. Before their numbers can reach significant proportions, however the salinity begins to increase and they are either forced back upstream or perish. Population densities of these "fresh-water" species appear to vary inversely with salinity.

The gar, Lepisosteus spatula, and the clupeid, Dorosoma cepedianum, were tolerant of all salinities observed and might well be considered euryhaline. Presumably spawning must take place in fresh water.

Eight species (Brevoortia patronus, Anchoa mitchilli, Syngnathus scovelli, Bairdiella chrysura, Eucinostomus argenteus, Gobiosoma bosci, Trinectes maculatus, and Mugil curema) are commonly found during part or all of their lives in salinities between fresh water and sea water. With the exception of the goby, all enter the Gulf at times. However, these species are probably not well adapted for life in salinities above 35 °/oo.

The remaining seven species (Fundulus grandis, Lucania parva, Cyprinodon variegatus, Mollienisia latipinna, Menidia beryllina, Mugil cephalus, and Dormitator maculatus) are particularly fitted for life in a wide range of salinities. They are able to maintain their populations in the river regardless of changes in salinity. Most of these species were represented in collections in which salinity and temperature were at extreme levels. They are among the hardiest of the smaller fishes found along the coast of the Gulf of Mexico. These are the fishes found most often and in greatest abundance along the shorelines of inside waters of the northwestern Gulf of Mexico.

3981. Sogandares-Bernal. Franklin, and John F. Bridgman. 1960. THREE ASCOCOTYLE COMPLEX TREMATODES (HETEROPHYIDAE) ENCYSTED IN FISHES FROM LOUISIANA, INCLUDING THE DESCRIPTION OF A NEW GENUS. Tulane Studies in Zoology, Vol. 8, No. 2, pp. 31-39.

The trematodes Ascocotyle leighi Burton, 1956; Parascocotyle diminuta Stunkard and Haviland, 1924 and Pseudoscocotyle mollienisicola n. gen., n. sp., (Ascocotylinae: Heterophyidae) were found encysted in poeciliid and cyprinodont fishes from brackish-water Lake Pontchartrain, Louisiana. All trematode species collected represent new locality records. New second-intermediate host records include Parascocotyle diminuta in Cyprinodon variegatus Lacepede, Fundulus grandis (Baird and Girard), Fundulus jenkinsi (Evermann), Lucania parva (Baird and Girard), and Mollienisia latipinna Le Sueur. Previously unknown anatomical details are given for Ascocotyle leighi. Metacercariae of all species reported were fed to experimental definitive hosts and mature trematodes were obtained. The present status of the Ascocotylinae is discussed. (Auth. abst.)

3982. Sundararaj, Bangalore I. 1960. AGE AND GROWTH OF THE SPOT, LEIOSTOMUS XANTHURUS LACEPEDE. Tulane Studies in Zoology, Vol. 8, No. 2, pp. 41-62.

Age and growth of the spot, Leiostomus xanthurus Lacepede, from Lake Pontchartrain area, Louisiana, were determined by the scale and otolith methods and verified by length-frequency method. For the study 1,418 spot obtained by various methods were used. Annuli on scales and otoliths were formed during February and early March. The maximum annual increase in length occurred during the first year. Thereafter, the growth rate decreased. An attempt was made to establish a relationship between the number of circuli and the age of spot. The longest specimen was 270 mm in total length and had attained the age of three and was in its fourth year of life. There was good agreement between scale year marks and otolith year rings from the same fish. The calculated lengths based on scales and those based on otoliths coincide closely, thereby indicating that either may be used for age determination in the spot. The length-frequency distributions of the spot show the growth of the young-of-the-year very well. Young spot taken at various stations in the lake exhibited differences in the growth rate. Presumably, young spot group in the lake after their entry and remain as more or less discrete populations through spring and summer. Growth of age group I could be traced, though incompletely, whereas growth of age group II could not be traced in the length-frequency distributions because of inadequate samples. (Auth. abst.)

3983. Helm, James M. 1960. RETURNS FROM MUSKELLUNGE STOCKING. Wisconsin Conservation Bulletin, Vol. 25, No. 6, pp. 1-2.

Ten years ago the department experimentally stocked High lake with yearling muskies at a cost of $1.62 each. They produced at least a 17 per cent return. On another water, little effect showed up. (From auth. abst.)

3984. Snow, Howard. 1960. BLUEGILL AT MURPHY FLOWAGE. Wisconsin Conservation Bulletin, Vol. 25, No. 3, pp. 1-4.

Under heavy fishing pressure without a bag limit, the bluegills of Murphy flowage showed no sign of

being "fished out." This research finding was a factor when Wisconsin discarded the panfish bag limit for 1960. (Auth. abst.)

3985. Brasch, John G. 1958. DRAWDOWNS: FISH MANAGEMENT TOOL. Wisconsin Conservation Bulletin, Vol. 23, No. 12, pp. 1-4.

It used to be accepted that drawdowns injure fishing. That's not always true. Under certain conditions they favor game fish by helping control carp and panfish. (Auth. abst.)

3986. Bjorkman, Robert. 1959. HEADWATERS TROUT REFUGES: DO THEY WORK? Wisconsin Conservation Bulletin, Vol. 24, No. 3, pp. 1-3.

The project stream, 3.3 miles long, was arbitrarily divided into four sections - A, B, C and D. For the last three years section A has been an experimental headwaters refuge. As a means of providing more fish for the angler, the headwaters refuge at Lawrence creek has not paid off during its first three years of operation. The brook trout that stay in the refuge, and the ones that enter it, are a total loss to the creel because they are still harvested by natural causes of mortality such as predators, parasites, and old age. Furthermore, the refuge made few contributions to downstream areas.

3987. Heding, Robert, and Vernon Hacker. 1960. A TROUT'S THERMOSTAT: SPRINGS. Wisconsin Conservation Bulletin, Vol. 25, No. 5, pp. 1-4.

Probably one of the least understood, but certainly one of the most vital of our natural resources is spring water - a rapidly-declining commodity in the conservation cupboard. Detrimental land use practices, constructing dams on small streams, digging ponds, and creating small impoundments in spring-fed areas of our trout streams all have a disastrous effect on the natural reproduction of trout.

3988. Druschba, Leonard J. 1959. ARE THE CARP MOVING NORTH? Wisconsin Conservation Bulletin, Vol. 24, No. 11, pp. 1-4.

Carp in problem numbers are showing up in certain northern waters. It is most likely that the primary means of transportation is man-made and the method of introduction is either through the minnow pail or unauthorized and unenlightened fish stocking by individuals.

3989. Paulin, Francis L. 1960. SNOW REMOVAL HEADS OFF WINTERKILL. Wisconsin Conservation Bulletin, Vol. 25, No. 2, pp. 1-2.

Snow removal activities as a means to avert winterkill of fish in lakes has the best chance of succeeding if the operations are begun before the dissolved oxygen level becomes critical. Also, it is important to start early just in case cloudy weather prevails following the snow removal. The snow-free areas should be of sufficient magnitude to prevent fish from bunching up in a small area, and to prevent snow from drifting in to plowed areas.

3990. Burdick, Milton, and Oscar Brynildson. 1960. FLY FISHING ONLY. Wisconsin Conservation Bulletin, Vol. 25, No. 6, pp. 1-4.

Four years of trial indicate fly bait and a 12-inch limit will not maintain good trout fishing on one stretch of the Peshtigo. Results might be different on a stream with better natural reproduction. (Auth. abst.)

3991. Brynildson, Clifford L., and Thomas Klick. 1959. FALL STOCKING HAS A PLACE. Wisconsin Conservation Bulletin, Vol. 24, No. 3, pp. 1-3.

The evidence accumulated in Wisconsin and other states now indicates that fall stocking of trout is practical only in streams where the fishing pressure is high and an overwinter survival of at least 50 percent can be achieved.

3992. Davis, James T. 1960. FISH POPULATIONS AND AQUATIC CONDITIONS IN POLLUTED WATERS IN LOUISIANA. Louisiana Wild Life and Fisheries Commission, Fisheries Section, Bulletin Number 1, 121 pgs.

All results from this study point to two conclusions. First, the pollutional load of the Ouachita River is apparently dropping. Actually, this may not be true. Instead, the increased flows of the last four years may have diluted the effluents to non-toxic level and thereby concealed their presence. If improvement of the river is to continue, wastes from two sources must receive treatment; Olin Paper Mill in West Monroe and sewage from Monroe and West Monroe are these offenders. In addition, wastes crossing the Arkansas-Louisiana line must be eliminated.

Second, better sampling methods applicable to southeastern streams must be devised and standardized. The present methods which were developed for the clear and/or shallow streams of northern United States either need revision or complete overhaul for use in our streams. This holds particularly true for the standards of clean-water species thus far developed.

This study at its completion failed to devise methods for general use in examination of polluted streams in Louisiana. Some of the methods need further study as indicated in the text. Others are ready for use under certain conditions as indicated. It is hoped that the opportunity for this needed research will be offered to qualified personnel in the southeast in the near future. In this way much can be accomplished. (Auth.)

3993. Grizzell, Roy A., Jr., 1960. FISH AND WILDLIFE MANAGEMENT ON WATERSHED PROJECTS. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 186-192.

Techniques in fish and wildlife management on small watersheds are many and varied as part of the approach to soil and water conservation and the prevention of floods.

A multiple-purpose drawdown slot in the overflow of reservoirs provides for control of undesir-

able weeds, waterfowl management, fish management, mosquito control, and downstream water supplies, Floodwater retarding reservoirs are favorable to fish management for both warm and cold water species. Waterfowl management within the impoundments and below the structures, is both practical and feasible.

A broader concept of resource use is developing as a result of the watershed program--involving soil, water, plant, fish and wildlife conservation. (Auth. summ.)

3994. Alexander, Harold E. 1960. STREAM VALUES, RECREATIONAL USE AND PRESERVATION. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 192-201.

We are carrying on a wide variety of water management programs under the jurisdiction of numerous governmental agencies, whose separate activities are limited by their authorities, and which fail to consider many important uses of water.

We are "developing" most of our natural streams to gain material objectives, and failing to consider inherent recreational, intangible and quality values. These intangibles include esthetic, historical and spiritual values of the utmost importance, which are comparable to those recognized for the arts, our family relationships, and our concept of democracy. These values cannot be estimated in dollar terms.

There is an acute awareness that we are rapidly losing our high quality streams, and that a positive program is needed to save the values they have for us in a natural state. So far there have been only sporadic efforts to save our streams.

There is a recognition that natural stream values will increase in ratio to their relative scarcity.

The natural scientist, with notable exceptions, has given most of his attention to material considerations, and has failed to consider criteria by which intangibles could be recognized and which would lead to an understanding of the significance of these values.

In managing water resources we have applied the slogan "the greatest good for the greatest number of people", without clearly understanding what this doctrine might imply, or recognizing our diverse and changing needs, now and in the future.

We should realize that we are taking courses of action in water management which are irreversible. The hour is late. These mighty structures of concrete and steel which are drowning the intangible values our streams possess are also fettering our freedom to choose the kind of world in which we and those who come after us would live. The perpetuation of that freedom is essential to the preservation of citizenship in our democracy. (Auth. concl.)

3995. Straty, Richard R. 1960. METHODS OF ENUMERATING SALMON IN ALASKA. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 286-297.

The regulation of Alaska's salmon fisheries and the success of biological studies currently in progress are dependent to a great degree upon precise counts of migrating salmon at the adult, smolt, and fry stages of their life cycle.

Estimation of adult red salmon escapements from observation towers is sufficiently precise to warrant the widespread use of towers in Bristol Bay.

Large cylindrical fyke traps on the Kenai River are useful in obtaining an index to the abundance of red salmon adults in turbid Alaskan streams.

Aerial surveys are the most economical and quickest method of obtaining immediate estimates of the escapement in Southeastern Alaska and Prince William Sound.

On small streams, surface or foot surveys are more accurate than aerial surveys for estimating the size of spawning populations. Their principal use is on streams where aerial surveys are not feasible or where a greater degree of accuracy is needed.

Fyke nets are fished in Bristol Bay in accordance with a pre-arranged schedule to obtain an estimate of red salmon smolts.

Arrays of rectangular fyke traps are used in Southeastern Alaska and Prince William Sound streams to estimate the total number of pink salmon fry produced.

A successful method of temporarily staining fry with neutral red is superior to fin clipping in mark and recovery experiments.

Random sampling of the intertidal stream's spawning areas with an "egg pump" provides a means of estimating the fry production where trapping methods are not possible. (Auth. summ.)

3996. Skud, Bernard E., and William B. Wilson. 1960. ROLE OF ESTUARINE WATERS IN GULF FISHERIES. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 320-326.

Most Gulf estuaries can be characterized as variable environments, in which the inhabitants must have broad tolerance limits. These shallow embayments are subject to rapid changes in such factors as temperature and salinity. Some estuaries are hypersaline but in most, the salinity varies from less than 1 °/oo to 25 °/oo. River discharge and flushing of salt marshes are probably the principal sources of nutrients.

The number of man-made changes in the estuaries and inflowing streams is increasing rapidly and expanded research is sorely needed to evaluate the effects of such changes on the estuarine species. (From auth. summ.)

3997. Walburg, Charles H. 1960. ABUNDANCE OF ST. JOHNS RIVER SHAD. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 327-333.

Scientific management of the St. Johns River shad population to obtain optimum yields is not now possible because factors affecting size of run are unknown. A number of elements could have an effect on the population by either increasing or decreas-

ing its size. Some examples are fishing, pollution, water temperature, stream flow, predation, and competition. Since the magnitude of the population is known for only 7 years, no conclusions can be made as to causes for fluctuations in abundance. After population parameters have been determined for an additional number of years, hypotheses may be formulated to account for changes in abundance. If factors affecting these changes can be determined and controlled, the St. Johns River shad population can then be managed on an optimum sustained yield basis. However, if they cannot be controlled, their effect could probably be predicted and the fishery managed accordingly. (Auth. disc.)

3998. Hartt, Allan C. 1960. PACIFIC SALMON IN INTERNATIONAL WATERS. Transactions of the Twenty-fifth North American Wildlife and Natural Resources Conference, pp. 339-346.

This paper is intended to present a brief outline of results to date of one phase of a large research program on Pacific salmon at sea, and of the particular problem which made the studies necessary. In addition to providing data for the purposes of the International North Pacific Fisheries Commission, the research is providing a wealth of information on the ocean biology of salmon, a field previously studied but little. The saltwater life-history of salmon and steelhead is proving no less remarkable than their much studied yet little understood freshwater life history. (Auth. summ.)

3999. Triplett, Edward L. 1960. NOTES ON THE LIFE HISTORY OF THE BARRED SURFPERCH, AMPHISTICUS ARGENTEUS AGASSIZ AND A TECHNIQUE FOR CULTURING EMBIOTOCID EMBRYOS. California Fish and Game, Vol. 46, No. 4, pp. 433-439.

The eggs, though relatively small, are distinctly telolecithal and in early development follow a pattern characteristic of most teleosts. As the development proceeds the fins increase in area proportionally to the increase in total weight. These hyperdeveloped fins, along with pleated folds projecting from the ovarian wall, probably serve as pseudo-placenta. Males attain sexual maturity sometime between birth and the first winter. Females with fewer than two annuli probably do not bear young. Old females bear more young per season and ovulate earlier than do young females. The gestation period is about five months and, depending upon the age of the parent, occurs sometime between November and June. Embryos of A. argenteus and Cymatogaster aggregata can be made to grow and differentiate in-vitro using a modification of White's medium as a culture fluid. (Auth. summ.)

4000. Hanzel, Delano A. 1959. THE DISTRIBUTION OF THE CUTTHROAT TROUT (SALMO CLARKI) IN MONTANA. Proceedings of the Montana Academy of Sciences 19:32-71.

4001. Lucas, K. C. 1960. THE ROBERTSON CREEK SPAWNING CHANNEL. The Canadian Fish Culturist, Issue Twenty-seven, August 1960, pp. 3-23.

The immediate operational plan for the spawning channel is to introduce and build up substantial runs of pink, coho and spring salmon in Robertson Creek. As well as providing for this development programme, the channel facilities were designed with sufficient flexibility to enable the carrying out of a host of applied and fundamental studies aimed at overcoming current multiple water-use and fisheries development problems.

The purpose of this paper has been to review salmon spawning channels which have recently been constructed and to describe the objectives and details of development of the Robertson Creek Spawning Channel. A detailed engineering description of the spawning channel and its appurtenant facilities as they stand in 1960 has been given. Where possible, design considerations and reasoning behind their adoption have been given. (From auth. summ.)

4002. Mackinnon, D. 1960. A SUCCESSFUL TRANSPLANT OF SALMON EGGS IN THE ROBERTSON CREEK SPAWNING CHANNEL. The Canadian Fish Culturist, Issue Twenty-seven, August, 1960, pp. 25-31.

A relatively large-scale eyed egg transplant of pink salmon into a newly-constructed spawning channel produced a fry output of 95% (91% of the number of eggs taken from fish). This extremely high survival is credited to near optimum conditions in the channel. (Auth. abst.)

4003. Jackson, K. J. 1960. A FIELD EXPERIMENT TO DETERMINE THE EFFECT UPON COHO SALMON FRY (ONCORHYNCHUS KISUTCH) FROM SPRAYING SAWLOGS WITH AN EMULSIFIED MIXTURE OF BENZENE HEXACHLORIDE. The Canadian Fish Culturist, Issue Twenty-seven, August, 1960, pp. 33-42.

The results of the experiment have shown that applications of emulsified benzene hexachloride at the concentrations cited (12.3 lbs. of gamma isomer per 34, 848 square feet) are lethal to coho fry held within 1 ft. of the surface. Fifteen minutes after spraying had ceased the average concentration of benzene hexachloride was still in excess (1.38 ppm) of the 1 ppm, cited as toxic to trout. The decrease in concentration of benzene hexachloride was shown to be exponential, and a calculation of initial concentration based upon the amount of gamma isomer applied indicates that it exceeded 1.38 ppm by a factor of three or four.

The results obtained from holding fish in a vertical gradient show that fish held at depths of more than 1 ft. were not killed.

The results obtained from holding fish in a vertical livebox showed that fish were not killed at depths of more than 1 ft. below the surface indicating that lethal concentrations of spray may be largely confined to the surface. (Auth. concl.)

4004. Gordon, R. N., R. A. Crouter, and J. S. Nelson. 1960. THE FISH FACILITIES AT THE

WHITEHORSE RAPIDS POWER DEVELOPMENT, YUKON TERRITORY. The Canadian Fish Culturist, Issue Twenty-seven, August 1960, pp. 43-56.

Although an accurate direct measure of delay to the migrating salmon was not obtained, the pattern and timing of migration as well as the observations made on behaviour and condition of fish at the development site indicate that the fish facilities operated satisfactorily. The fact that the migration pattern is not skewed; that 96 percent of the migration took place in a 21-day period; that condition of the salmon remained good throughout the migration; that there was no evidence of spawning below the facilities; that there was a lack of injury and that there was an absence of any major accumulation below the barrier dam, all suggest that the salmon were not seriously interrupted in their migration.

Specific observations indicated that each unit of the fish facilities operated satisfactorily. Attraction into and movement through the fishway of salmon and grayling appeared to be good, the barrier dam apparently formed a complete obstruction to migration and there were no migration problems at the powerhouse collection facilities during 1959. (Auth. disc.)

4005. Buck, D. Homer, Maurice A. Whitacre, and Charles F. Thoits, III. 1960. SOME EXPERIMENTS IN THE BAITING OF CARP. The Journal of Wildlife Management, Vol. 24, No. 4, pp. 357-364.

Experiments were carried out on 225-acre Slocum Lake, 1.4-acre Oxbow Lake, and 4.2-acre Long Lake to test the use of corn for baiting carp to a small area where they could be enclosed and killed with rotenone. Sour corn seemed to repel most other fishes so that large numbers of carp, and possibly catfishes, could be concentrated and killed with small loss of game fishes. Removal of 93.6 percent (by weight) of the lake's carp population was obtained by one treatment of the baited area in 1.4-acre Oxbow Lake. Results indicated 2 or 3 repetitions might be required in lakes up to 10 acres in size. Control in lakes as large as Slocum (225 acres) would require several treatments in each of several widely separated areas. With continuous baiting, carp can be reconcentrated at fairly short intervals of time. At Slocum Lake, 5,871 pounds of carp were attracted to the baited area and killed there within 36 to 48 hours following a first treatment with rotenone. The best use of the technique would involve establishment of permanent, continuously baited areas, where carp could be killed as often as they could be concentrated at the bait. (Auth. summ.)

4006. Lynn, Walter R., and Won Tak Yang. 1960. THE ECOLOGICAL EFFECTS OF SEWAGE IN BISCAYNE BAY. OXYGEN DEMAND AND ORGANIC CARBON DETERMINATIONS. Bulletin of Marine Science on the Gulf and Caribbean, Vol. 10, No. 4, pp. 491-509.

An evaluation of manometric techniques in measuring biochemical oxygen demand in bay-bottom sediments indicates limitations of the method. A wet-oxidation method for the determination of organic carbon is proposed and compared with manometric methods. Carbon determinations are shown to have valid relationship which reflects the readily oxidizable portion of the sediment. The proposed method offers a quantitative relative measure of the carbonaceous content of the benthal deposit; is a simple and rapid test having utility comparable to that obtained utilizing the Warburg; and eliminates the complex experimental procedures and equipment associated with the Warburg B.O.D. test. (Auth. abst.)

4007. Hubbs, Clark, and Exalton A. Delco, Jr. 1960. MATE PREFERENCE IN MALES OF FOUR SPECIES OF GAMBUSIINE FISHES. Evolution, Vol. XIV, No. 2, pp. 145-152

Males of most species of Gambusia court females of their own species far more than they court females of other species. The only exceptions to the above are the males of Gambusia affinis and G. heterochir, which have not been shown to be able to distinguish between females of those two species. These two species exhibit the highest known incidence of natural interspecific hybridization of any gambusiine fishes. In addition to the lack of pronounced mate recognition between G. affinis and G. heterochir, males appear to prefer females of closely related species over more distantly related females. Two hybrid males between G. affinis and G. heterochir have shown a very low sexual activity. Males of species thought to have been sympatric with closely related species are more discriminating than males thought to have been allopatric to their close relatives. (Auth. concl.)

4008. Anonymous. 1959. A PROSPECTUS FOR MARINE GAME FISH RESEARCH, U. S. Fish and Wildlife Service, Bureau of Sport Fisheries and Wildlife, 12 pgs.

Included in this paper are: legislative authorities and directors for marine game fish research; important marine game fish of the U. S.; why marine game fish research is important; the Federal functions in marine game fish research; what should we have accomplished from five years of marine game fish research?; the research staff and facilities; and development of the game fish research program.

4009. Anonymous. 1959. APPARATUS FOR TAKING WATER SAMPLES AT ANY DESIRED DEPTH. Gas- u. Wasserfach, 1959, 100, 307; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1175. 1960.

An illustrated description is given of apparatus by which samples of water can be taken from any desired depth, uncontaminated by water from other depths. The apparatus is suitable for obtaining samples for bacteriological, biological, and chemical examination.

4010. Chang, S. L., G. Walton, R. L. Woodward, and B. B. Berger. 1959. EFFECT OF DISINFECTING AGENTS ON EVAPORATION REDUCTION WITH

HEXADECANOL. J. Amer. Wat. Wks Ass., 1959, 51, 1421-1432; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1186. 1960.

Studies have been made on various factors affecting the use of monomolecular films of hexadecanol for retarding evaporation of water. It was found that for maximum effectiveness the hexadecanol should be applied in the form of particles 1.5-2.0 mm in diameter and dispersed over the water surface. It was also found that the presence of hexadecanol promotes the growth of certain bacteria, including species of Pseudomonas and Flavobacterium, and this is accompanied by destruction of the film and interference with its repair. The incorporation into the hexadecanol preparations of certain bactericides reduces the efficiency of the film over a period of about 2 days, but is more effective for retarding evaporation over longer periods. Formulations consisting of hexadecanol and a bactericide should have no significant toxicity to humans, should not reduce the film pressure appreciably, and should resist biological attack and photochemical breakdown. The health hazard to humans of including bactericidal agents in hexadecanol formulations is still to be evaluated, and the economic value of such formulations is still to be determined by comparing the savings in less frequent applications of hexadecanol with the increased cost of the chemical.

4011. Landgrebe, H. 1958. SUPERVISION OF THE IMPERMEABILITY OF HEATING OIL STORAGE TANKS. Sanit. Tech., Berl. 23, 441; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1286. 1960.

To protect ground water it is proposed that underground oil tanks should have at the base on both sides drainage pipes with gravity flow to a vertical shaft. In sandy soil a clay layer should be laid at the base and the drainage pipes, embedded in gravel, should be laid on this. Control observations should be made about twice yearly.

4012. Cairns, J., and A. Scheier. 1959. THE EFFECTS OF TEMPERATURE AND HARDNESS OF WATER UPON THE TOXICITY OF POTASSIUM DICHROMATE TO THE COMMON BLUEGILL SUNFISH. Trans. northeast Wildl. Conf. 1958; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1298. 1960.

Experiments were carried out on the toxicity of potassium dichromate to the bluegill sunfish in both soft and hard water at 18°C and at 30°C during exposure for periods of up to 96 hours. Results are tabulated. The toxicity of dichromate was affected more by the degree of hardness of the water than by the temperature. The experimental concentrations of dichromate that resulted in 50 percent death of sunfish in 96 hours were 320 p.p.m. in soft water at both 18° and 30°C, 382 p.p.m. in hard water at 18°C, and 369 p.p.m. in hard water at 30°C.

4013. Pritchard, A. L. 1954. POLLUTION AND THE FISHERIES. Pap. 1st Ontario Industr. Waste Conf., 1954, 115-119; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1308. 1960.

The author reviews the types of pollution which have an adverse effect on fish, legislation controlling pollution in Canada, and examples of procedures used by Fisheries Departments to reduce pollution in various parts of Canada.

4014. Ide, F. P. 1954. POLLUTION IN RELATION TO STREAM LIFE. Pap. 1st Ontario Industr. Waste Conf., 1954, 86-108; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1309. 1960.

The author reviews, from the literature, the effects of different types of pollution on the biology of streams, and stresses the usefulness of biological indicators of pollution. The dangers of indiscriminate use of plant, fish, and insect poisons in streams, where the biological balance may be upset, are emphasized. A bibliography of 85 references is appended.

4015. Townsley, S. J., D. F. Reid, and W. T. Ego. 1959. UPTAKE OF RADIO-ISOTOPES AND THEIR TRANSFER THROUGH FOOD CHAINS BY MARINE ORGANISMS. U.S. Atom. Energ. Comm., AECU-4350, 1959, 48 pp; Water Pollution Abstracts, Vol. 33, No. 7, Abst. No. 1321. 1960.

A method has been developed for the interpretation of the results of radioactive tracer experiments with aquatic animals, and its application to the prediction of possible radioactive contamination in known environmental conditions is discussed. Environmental and physiological factors affecting the uptake of radioactive isotopes by Tilapia mossambica have been investigated. The results are given of preliminary tests to determine which radioactive isotopes and organisms are best suited for the study of the exchange of ions through food chains in the marine environment.

4016. Stundl, K. 1957. WATER PROBLEMS IN POLLUTED IMPOUNDING RESERVOIRS. Wass. u. Abwass., 1957, 2, 85-95; Water Pollution Abstracts, Vol. 33, No. 8, Abst. No. 1514. 1960.

The author gives a general account, with references to the literature, of the difficulties experienced when waters are impounded by dams, especially if the influent to the reservoir is polluted. Subjects discussed include sedimentation of suspended matter, decomposition of accumulated silt, oxygen conditions, and biological processes. The problem of silt accumulation has been dealt with in some cases by constructing a preliminary sedimentation basin with facilities for silt removal before the reservoir. Another suggestion has been to stir up the silt with scrapers and direct it to the path of the old river bed, along which the incoming water flows. Each reservoir, however, must be examined as an individual case.

4017. Marsden, K. 1959. DETERMINATION OF TRACES OF CYANIDE IN FISH TISSUE. Analyst, 1959, 84, 746-747; Water Pollution Abstracts, Vol. 33, No. 8, Abst. No. 1523. 1960.

A method is described for the determination of cyanide in fish tissue, using the gill filaments. The

cyanide is extracted by Conway's microdiffusion technique, and the recovered cyanide is determined absorptiometrically using the pyridine-pyrazolone reagent. In tests on the recovery of cyanide from healthy tissue, the mean recovery was 97.7 per cent, and the standard error 1.11 per cent. To detect the occurrence of cyanide poisoning in a river, it is recommended that the sample should consist of at least five fish (preferably found dead in the water), and that the tissues should be kept under refrigeration and examined as soon as possible after death. Salmon exposed to water containing 50 p.p.m. cyanide at 4°C died in 20-30 minutes and the gills contained about 2.5 p.p.m. cyanide when examined 4 hours after death, but only about 0.5 p.p.m. when examined 3 days later after storage at 20°C.

4018. Edwards, R. W., and M. Owens. 1960. THE EFFECTS OF PLANTS ON RIVER CONDITIONS. I. SUMMER CROPS AND ESTIMATES OF NET PRODUCTIVITY OF MACROPHYTES IN A CHALK STREAM. J. Ecol., 48, 151-160; Water Pollution Abstracts, Vol. 33, No. 9, Abst. No. 1576. 1960.

In connection with studies to assess some of the effects which aquatic plants have on river conditions, a preliminary study was made to find suitable methods for estimating amounts of aquatic macrophytes in the river Ivel, Herts, a tributary of the Great Ouse. It was found that spin drying, using a converted domestic spin drier, had certain advantages over the usual air-drying method for determining fresh weight of the plants. Spin drying gives less variable results, and is rapid and easy to operate. Between June and September 1958, the crops of aquatic plants in the river Ivel, a chalk stream, increased from 160 g to 520 g of dry weight per sq. m, representing a net primary productivity of 1.44 g of organic carbon per sq. m per day. The efficiency of utilization of solar energy was 0.42 per cent. The average daily increase in dissolved oxygen concentration as a result of plant growth was calculated to be equivalent to about 1.65 p.p.m. per mile.

4019. Schweng. 1957. POLLUTION OF STREAMS AND FISHERIES. Ber. Abwass Techn. Verein., No. 8, 374-381; Water Pollution Abstracts, Vol. 33, No. 9, Abst. No. 1686. 1960.

The author deals with the biological effects of chemical and mechanical pollution of waters and with the importance of the condition of fish as an indication of pollution. He describes the changes in the fish population caused by pollution, with special reference to the Rhine, which by continued pollution has been changed from a salmon to an eel river and in which even the eel population is decreasing. In many streams a trout population has been replaced by bleak and pike. Another indication of pollution is the effect of oil and phenols on the taste of fish. The catching of fish is also affected by pollution, nets and other apparatus being clogged and damaged by fungus. The importance of observations of fish in indicating biological changes in water is emphasized.

4020. Tarzwell, C. M. 1955. WATER QUALITY CRITERIA FOR AQUATIC LIFE. Pap. 2nd Ontario Industr. Waste Conf., 1955, 50-82; Water Pollution Abstracts, Vol. 33, No. 9, Abst. No. 1688. 1960.

The author discusses the requirements for maintaining a satisfactory environment for the protection of aquatic life, with special reference to the effects on fish of temperature, settleable solids and turbidity, pH value, dissolved oxygen, carbon dioxide, dissolved solids, chlorides, fluorides, and toxic materials. It is considered that numerical criteria can be established only for temperature (the limits depending on the species of fish), pH value (which should be in the range 5-9.5, and preferably, for good fish production, between 6.5 and 8.5), and dissolved oxygen (which should not be below 5 p.p.m. for more than 8 hours in any 24-hour period, and should never fall below 3 p.p.m., higher limits being required for some species of fish such as Salmonoids). The quality of a stream is particularly important in determining the effects of many waste waters; the toxicity of contaminants is affected by temperature, carbon dioxide, dissolved oxygen, pH value, alkalinity, hardness, and dissolved materials, and may also be modified by complexation, precipitation, oxidation, synergy, and antagonism. The maximum permissible concentration of toxic complex wastes should be determined for each stream by means of bio-assays. A list of 69 references is appended.

4021. Anonymous. 1959. NEW REED-KILLER TESTED BY KENT RIVER BOARD. Surveyor, Lond., 1959, 118, 804; Water Pollution Abstracts, Vol. 33, No. 9, Abst.No. 1694. 1960.

Trials to test the new reed-killer, "Dowpon", have been carried out during the past year by the Kent River Board in an attempt to reduce the high cost of reed control in the Romney Marsh area. Doses of between 20 and 40 lb of the chemical per acre were applied to the watercourses by a knapsack sprayer and the results obtained were very successful. Dowpon, in the recommended doses, is claimed to be non-toxic to fish and waterfowl.

4022. Mechanik, F. J. 1957. THE EFFECT OF OXYGEN CONCENTRATION IN WATER ON THE GROWTH AND NITROGEN EXCHANGE OF RAINBOW TROUT FRY. Rybnoe Khoz., 1957, 33, No. 3, 74-75; Water Pollution Abstracts, Vol. 33, No. 10, Abst. No. 1771. 1960.

Reduction in the oxygen concentration in water hinders development of rainbow trout fry. With a low oxygen concentration, both in favourable and unfavourable conditions of temperature, the amount of the nitrogen-containing fraction of nutrient matter assimilated was considerably reduced. The reduced capacity for utilizing nutrient proteins at unfavourably high temperatures is primarily a result of the lower level of saturation of the water with oxygen. A high concentration of oxygen in water is important for the development of trout fry.

4023. Bulicek, J. 1957. ARTIFICIAL AERATION OF WATER IN THE MOLDAU IMPOUNDING RESERVOIRS AND IN CZECH RIVERS. J. Vodn. hospod., 1957, No. 9; Water Pollution Abstracts, Vol. 33, No. 10, Abst. No. 1910. 1960.

Death of fish caused by oxygen deficiency in summer is a serious problem in impounding reservoirs on the Moldau. Efforts to save fish by removing them and to aerate the water with paddle steamers had little success. Better results were obtained by lowering the dam. The author discusses known methods of artificial aeration. It is proposed to experiment with various aeration systems, including paddles, Kessener brushes, and sprays. The author concludes that by these methods it is only possible to provide limited aerated areas in which fish can take refuge. He discusses briefly a proposal to add oxygenating chemicals to the water.

4024. Shiffman, R. H. 1958. THE UPTAKE OF STRONTIUM FROM DIET AND WATER BY RAINBOW TROUT. Hanford Biol. Res. Ann. Rep. 1958, U. S. Atom Energ. Comm., HW-59500, 1959, 16-19; Water Pollution Abstracts, Vol. 33, No. 10, Abst. No. 1932. 1960.

The concentration of strontium-90 in trout approached 1.5 times the concentration in the surrounding water in three weeks. When the isotope was administered in gelatine capsules about 21 per cent was retained after one day, but the retention was only about 7 per cent when the isotope was incorporated into natural food. Fish which ingested 0.24 μc of strontium per day showed evidence of damage to the gut.

4025. Neil, J. H. 1956. TOXICITY OF CYANIDES TO FISH. Pap. 3rd Ontario Industr. Waste Conf., 1956, 125-129; Water Pollution Abstracts, Vol. 33, No. 11, Abst. No. 2137. 1960.

In order to assess the dangers of cyanide poisoning in Ontario waters, an experiment was carried out to determine the effect of cyanide on native fish. Using 4-in. speckled trout as the test fish, concentrations of cyanide as low as 0.08 p.p.m. were found to cause immediate signs of distress. The environmental factors affecting the toxicity of cyanide to fish are discussed, and consideration is also given to the toxicity of complex cyanides (which are unstable under certain conditions and must therefore be regarded as a potential source of cyanide), and other compounds which may be formed by combination of cyanide with other constituents of the waste water or stream. Bio-assays are recommended to determine whether a particular cyanide waste water can be discharged safely to a stream, and also to determine the dilution factor which must be maintained.

4026. Pyefinch, K. A. 1960. TROUT IN SCOTLAND. A STORY OF BROWN TROUT RESEARCH AT PITLOCHRY. H.M. Stationery Office, Edinburgh, 1960, 80 pp.; Water Pollution Abstracts, Vol. 33, No. 12, Abst. No. 2205. 1960.

An illustrated account is given of the 10 years' research carried out at the Brown Trout Research Laboratory of the Scottish Home Department at Pitlochry, Perthshire, from its inception in 1948 until the decision to give more attention to work on salmon, the Laboratory being suitably renamed the Freshwater Fisheries Laboratory. The aspects considered include the breeding activities and behaviour of the brown trout, the environment of the trout, and the improvement of the trout fisheries (including the enrichment of the water in lochs with minerals, and the elimination of predators); graphical and tabulated data are included, the practical applications of the results are discussed, and a classified list of references is provided.

****

AUTHOR INDEX

Adams, James R. and A. Prakash.
A histopathological study of the intestinal lesions induced by Echinorhynchus lageniformis (Acanthocephala-Echinorhynchidae) in the starry flounder. 3869

Ahlmquist, Elisabeth.
Observations on the effect of rotenone emulsives on fish food organisms. 3918

Alexander, Harold E.
Stream values, recreational use and preservation. 3994

Allen, George H. and Gerald A. Sanger.
Fecundity of rainbow trout from actual count of eggs. 3859

Alverson, Franklin G.
Distribution of fishing effort and resulting tuna catches from the eastern tropical Pacific by quarters of the year, 1951-1958. 3830

Ananichev, A. V.
Digestive enzymes of fish and seasonal changes in their activity. 3946

Anonymous.
Symposium on fish behaviour. 3814
Toxic effects of organic and inorganic pollutants on young salmon and trout. 3815
A prospectus for marine game fish research. 4008
Apparatus for taking water samples at any desired depth. 4009
New reed-killer tested by Kent River Board. 4021

Aquatic Life Advisory Committee.
Aquatic Life Water Quality Criteria. 3915

Bagenal, T. B.
The fecundity of English Channel plaice. 3908
The fecundity of plaice from the south and west coasts of Ireland. 3909

Bailey, Jack E., A. John Ross, Phyllis R. Mordstrom, and John R. Heaton.
A bacterial disease of yellow perch (Perca flavescens). 3972

Ball, J. N. and J. W. Jones.
The growth of the brown trout of Llyn Tegid. 3842

Balon, Eugeniusz.
Spawning of Lepomis gibbosus (Linne, 1758), Acclimatized in the black waters of the Danube and its development during the embryonic period. (Neres Lepomis gibbosus (Linne, 1758) aklimatizovanej V Bocnych Vodach Dunaja A jej vyvoj pocas embryonalnej periody.) 3900

Bartsch, A. F. and W. M. Ingram.
Graphic expression of biological data in water pollution reports. 3932

Bennett, George W., Donald F. Hansen, Robert J. Webb, and John M. Lewis.
Hook-and-line catch in fertilized and unfertilized ponds. 3831

Ben-Tuvia, Adam.
The biology of the cichlid fishes of Lakes Tiberias and Huleh. 3938

Berezina, N. A.
The use of insecticides to control predaceous insects which are enemies of fish. 3832

Berger, B. B., S. L. Chang, G. Walton, and R. L. Woodward.
Effect of disinfecting agents on evaporation reduction with hexadecanol. 4010

Bernatowicz, S., and J. Radziej.
Quantitative studies on the vascular flora of Lake Dobskie (Badania Ilosciowe Flory Naczyniowej Jeziora Dobskiego.) 3885

Beverton, J. H., I. D. Richardson, D. H. Cushing, F. R. Harden Jones and R. W. Blacker.
Echo sounding experiments in the Barents Sea. 3840

Beyerle, George B. and Edwin L. Cooper.
Growth of brown trout in selected Pennsylvania streams. 3963

Bhattacharya, Nikhilesh, D. N. Ganguly and Biswanath Misra.
On the Interrelationships between total length, standard length, depth and weight of Lates calcarifer. 3925

Bjorkman, Robert.
Headwaters trout refuges: do they work? 3986

Blacker, R. W., I. D. Richardson, D. H. Cushing, F. R. Harden Jones and R. J. H. Beverton.
Echo sounding experiments in the Barents Sea. 3840

Braginskiy, L. P.
Dimension and weight characteristics of the leading forms of reservoir zooplankton. 3931

Branson, Branley A., Clarence J. McCoy, Jr. and Morgan E. Sisk.
Notes on the freshwater fishes of Sonora with an addition to the known fauna. 3864

Brasch, John G.
Drawdowns: fish management tool. 3985

Bridgman, John F. and Franklin Sogandares-Bernal.
Three ascocotyle complex trematodes (Heterophyidae) encysted in fishes from Louisiana, including the description of a new genus. 3981

Briggs, John C.
Fishes of worldwide (circumtropical) distribution. 3867

Broadhead, Gordon C. and Craig J. Orange.
Species and size relationship within schools of yellowfin and skipjack tuna, as indicated by catches in the eastern tropical Pacific Ocean.

Brocato, Frank, Kenneth S. Norris and Frank Calandrino.
A survey of fish transportation methods and equipment. 3854

Brock, Vernon E. and Robert H. Riffenburgh.
Fish schooling: a possible factor in reducing predation. 3879

Brouardel, Jean and Emile Rinck.
Apparatus employed in the Mediterranean for the study of the production of organic material. (Appareillage employe en Mediterranee pour

l'etude de la production de matiere organique.) 3958

Brunel, Pierre.
Artificial key to the Mysidacea of the Canadian Atlantic Continental Shelf. 3873

Brynildson, Clifford L. and Thomas Klick.
Fall stocking has a place. 3991

Brynildson, Oscar and Milton Burdick.
Fly fishing only. 3990

Bryson, Reid A. and Robert A. Ragotzkie.
On internal waves in lakes. 3824

Buck, D. Homer, Maurice A. Whitacre and Charles F. Thoits, III.
Some experiments in the baiting of carp. 4005

Budd, John C.
Survival and growth of tagged lake trout in South Bay, Lake Huron. 3971

Bulicek, J.
Artificial aeration of water in the Moldau impounding reservoirs and in Czech rivers. 4023

Burdick, Milton. and Oscar Brynildson.
Fly fishing only. 3990

Butcher, R. W.
Symposium on water pollution. 3959

Byczkowska-Smyk, Wanda.
The respiratory surface of the gills in teleosts. II. The respiratory surface of the gills in the eel (Anguilla anguilla L.), the Loach (Misgurnus fossilis L.) and the perch pike (Lucioperca lucioperca L.) 3924

Cairns, J. and A. Scheier.
The effects of temperature and hardness of water upon the toxicity of potassium dichromate to the common bluegill sunfish. 4012

Calandrino, Frank, Kenneth S. Norris and Frank Brocato.
A survey of fish transportation methods and equipment. 3854

Carlander, Kenneth D., Richard R. Whitney, Everett B. Speaker, and Kenneth Madden.
Evaluation of walleye fry stocking in Clear Lake, Iowa, by alternate-year planting. 3962

Carufel, Louis H.
Evaluation of commercial fishery by use of a questionnaire. 3891

Chakravarti, Diptiman and Timothy Joyner.
Potassium as an index of naturally occurring radioactivity in tuna muscle. 3973

Chambers, Gilvert V. and Albert K. Sparks.
An ecological survey of the Houston ship channel and adjacent bays. 3845

Chang, S. L., G. Walton, R. L. Woodward and B. B. Berger.
Effect of disinfecting agents on evaporation reduction with hexadecanol. 4010

Charlton, W. H. and M. G. Johnson.
Some effects of temperature on the metabolism and activity of the largemouth bass, Micropterus salmoides Lacepede. 3890

Cooper, Edwin L. and George B. Beyerle.
Growth of brown trout in selected Pennsylvania streams. 3963

Craig, R. E. and R. Priestley.
Photographic studies on fish populations. 3827

Crouter, R. A., R. N. Gordon and J. S. Nelson.
The fish facilities at the Whitehorse Rapids power development, Yukon Territory. 4004

Cushing, D. H., I. E. Richardson, F. R. Harden Jones, R. J. H. Beverton, and R. W. Blacker.
Echo sounding experiments in the Barents Sea. 3840

Davis, James T.
Fish populations and aquatic conditions in polluted waters in Louisiana. 3992

Davis, John H.
Proposals concerning the concept of habitat and a classification of types. 3820

Delco, Exalton A., Jr. and Clark Hubbs.
Mate preference in males of four species of gambusiine fishes. 4007

Denton, Eric.
The buoyancy of marine animals. 3914

de Oliveira, Lejeune P. H., Rubem do Nascimento, Luiza Krau, and Arnaldo Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. (Observacoes hidrobiologicas sobre a mortalidade de peixes na lagoa de Camorim.) 3928

Deubler, Earl E., Jr.
Salinity as a factor in the control of growth and survival of postlarvae of the southern flounder, Paralichthys lethostigma. 3875

Deubler, Earl E., Jr. and Brian J. Rothschild.
Paralichthys squamilentus Jordan and Gilbert from North Carolina. 3858

do Nascimento, Rubem, Lejeune P. H. de Oliveira, Luiza Krau, and Arnaldo Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. (Observacies hidrobiologicas sobre a mortalidade de peixes na lagoa de Camorim.) 3928

Doxtator, E. A. and C. F. Nicholls.
An aquarium for maintaining constant prey population densities in studies of predator-prey interactions. 3979

Drewry, George E. and Clark Hubbs.
Survival of F_1 hybrids between cyprinodont fishes with a discussion of the correlation between hybridization and phylogenetic relationship. 3848

Druschba, Leonard J.
Are the carp moving north? 3988

Dumas, R. F., Arthur M. Phillips, Jr., and D. L. Livingston.
The effect of starvation and feeding on the chemical composition of brook trout. 3892

Dunbar, C. E., S. F. Snieszko, Ken Wolf, and E. Pyle.
The virus nature of infectious pancreatic necrosis in trout. 3955

Edwards, R. W. and M. Owens.
The effects of plants on river conditions. I. Summer crops and estimates of net productivity of macrophytes in a chalk stream. 4018

Ego, W. T., S. J. Townsley and D. R. Reid.
Uptake of radio-isotopes and their transfer through food chains by marine organisms. 4015

Elder, J. B. and Otto W. Tiemeier.
Growth of stunted channel catfish. 3887

Farris, David A.
The effect of three different types of growth curves on estimates of larval fish survival. 3878
Fisk, Leonard O. and J. B. Kimsey.
Keys to the freshwater and anadromous fishes of California. 3835
Francois, Y.
The comparative anatomy and evolution of the dorsal fin (La nageoire dorsale anatomie comparee et evolution.) 3954
Frank, Stanislav.
A contribution to the growth of the common brown trout (Salmo trutta M. fario L.) in Klicava Valley Reservoir. (Prispevek k rustu pstruha obecneho f. potoncni (Salmo trutta M. fario L.) v Klicavski udolni nadrzi.)
French, Robert R.
Rainbow trouts, Salmo gairdneri, with anomalous caudal and pelvic fins. 3862
Fucugauchi, Maria Elena.
Radioactive measurements in the living fish. 3944
Furukawa, Ichiro
Studies on the set net fishery of the yellowtail, Seriola quinqueradiata, in Hyuga Nada (1) 3919

Ganguly, D. N., Biswanath Misra, and Nikhilesh Bhattacharya.
On the inter-relationships between total length, standard length, depth and weight of Lates calcarifer. 3925
Gannon, J. J. and C. J. Velz.
Forecasting heat loss in ponds and streams. 3917
Garlick, Lewis R. and Jack E. Hemphill.
The development of sport fishery resources on Indian lands in the southwest. 3965
Gerbilsky, N. L.
The question of the migratory impulse in connection with the analysis of intraspecific biological groups. 3834
Gieysztor, M.
On the thermal conditions of the littoral zone of lakes. 3884
Goldman, C. R.
Molybdenum as a factor limiting primary productivity in Castle Lake, California. 3857
Gordon, R. N., R. A. Crouter, and J. S. Nelson
The fish facilities at the Whitehorse Rapids power development, Yukon Territory. 4004
Gosline, William A.
Contributions toward a classification of modern Isospondylous fishes. 3913
Green, Norval, Earl S. Herald, Walter Schneebeli, and Kenneth Innes.
Catch records for seventeen shark derbies held at Elkhorn Slough, Monterey Bay, California. 3853
Greenwood, P. H.
A revision of the Lake Victoria Haplochromis species (Pisces, Cichlidae). Part IV. 3837
Grizzell, Roy A., Jr.
Fish and wildlife management on watershed projects. 3993
Grodzinski, Z.
The development of the lymph heart in sea-trout Salmo trutta L. 3947
Guiton, Philip.
On the control of behaviour during the reproductive cycle of Gasterosteus aculeatus. 3926

Hacker, Vernon and Robert Heding.
A trout's thermostat: springs. 3987
Halsband, E. and P. F. Meyer-Waarden.
Entwicklung eines elektrobiologischen testes zur bestimmung der abwasserlast von flussen. 3906
Halsband, E., P. F. Meyer-Waarden and Inge Halsband.
Bibliographie uber die Elektrofisherei und Ihre Grundlagen. 3901
Halsband, Inge. P. F. Meyer-Waarden and Egon Halsband.
Bibliographie uber die Elektrofischerei und Ihre Grundlagen. 3901
Halver, J. E., E. M. Wood, W. T. Yasutake, and A. N. Woodall.
Chemical and histological studies of wild and hatchery salmon in fresh water. 3970
Hansen, Donald F., George W. Bennett, Robert J. Webb and John M. Lewis.
Hook-and-line catch in fertilized and unfertilized ponds. 3831
Hanzel, A. Delano.
The distribution of the cutthroat trout (Salmo clarki) in Montana. 4000
Harder, Wilhelm.
Zuranatomie des darmtraktes einiger gadiformes und macruriformes (Osteichthyes, Pisces). 3882
Hartman, W. L. and John L. Wagner.
An underwater camera case. 3888
Hartt, Allan C.
Pacific salmon in international waters. 3998
Healy, Ann and Michael Kennedy.
Trout in Lough Glore Co., Westmeath, Ireland. 3868
Heaton, John R., A. John Ross, Phyllis R. Mordstrom, and Jack E. Bailey.
A bacterial disease of yellow perch (Perca flavescens). 3972
Hederstrom, Hans.
Observations on the Age of Fishes. 3920
Heding, Robert and Vernon Hacker.
A trout's thermostat: springs. 3987
Helm, James M.
Returns from muskellunge stocking. 3983
Hemphill, Jack E. and Lewis R. Garlick.
The development of sport fishery resources on Indian lands in the southwest. 3965
Herald, Earl S., Walter Schneebeli, Norval Green and Kenneth Innes.
Catch records for seventeen shark derbies held at Elkhorn Slough, Monterey Bay, California. 3853

Hesser, E. F.
Methods for routine fish hematology. 3893
Hewson, L. C.
A history of the Lake Winnipeg fishery for whitefish, Coregonus clupeaformis, with some reference to its economics. 3975
Hilsenhoff, William L.
Treating water areas with granular insecticides. 3950
Hirano, Toshiyuki and Kenzo Sugiura.
On the salinity distribution in a small bay with river discharge. 3929
Hitchcock, Stephen W.
Effects of an aerial DDT spray on aquatic insects in Connecticut. 3960
Hiyama, Yoshio, Yukio Nose, Makoto Shimizu, Junko Matsubara, Koshi Onodera, Yasuo Kodama, and Norio Suzuki.
Predation of rainbow trout fry traced by radioisotope. 3852
Hnatevic, B.
Das wachstum des barsches (Perca fluviatilis L.) in dem oravastaubecken (Slowakei). 3895
Hoese, H. Dickson and Ernest G. Simmons.
Studies on the hydrography and fish migration of Cedar Bayou, a natural tidal inlet on the central Texas coast. 3849
Holt, Romona Denton.
Comparative morphometry of the mountain whitefish, Prosopium williamsoni. 3816
Hubbs, Carl L., and Robert Rush Miller.
The spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River system. 3939.
Hubbs, Clark, and Exalton A. Delco, Jr.
Mate preference in males of four species of gambusiine fishes. 4007
Hubbs, Clark, and George E. Drewry.
Survival of F_1 hybrids between cyprinodont fishes, with a discussion of the correlation between hybridization and phylogenetic relationship. 3848.

Ide, F. P.
Pollution in relation to stream life. 4014
Ingram, W. M. and A. F. Bartsch.
Graphic expression of biological data in water pollution reports. 3932
Innes, Kenneth, Earl S. Hearld, Walter Schneebeli, and Norval Green.
Catch records for seventeen shark derbies held at Elkhorn Slough, Monterey Bay, California. 3853
Irie, Takaaki.
The growth of the fish otolith. 3839
Ishio, Shinya.
The reactions of fishes to toxic substances --- II. The reactions of fishes to acids. 3850

Jackson, K. J.
A field experiment to determine the effect upon coho salmon fry (Oncorhynchus kisutch) from spraying sawlogs with an emulsified mixture of benzene hexachloride. 4003
Johnson, M. G., and W. H. Charlton.
Some effects of temperature on the metabolism and activity of the largemouth bass, Micropterus salmoides Lacapede). 3890
Jones, J. W. and J. N. Ball.
The growth of the brown trout of Llyn Tegid. 3842
Jones, R. F. Harden, I. D. Richardson, D. H. Cushing, J. H. Beverton, and R. W. Blacker.
Echo sounding experiments in the Barents Sea. 3840
Joyner, Timothy and Diptiman Chakravarti.
Potassium as an index of naturally occurring radioactivity in tuna muscle. 3973

Kajak, Z.
The representativeness of benthic samples. 3933
Karzinkin, G. S., E. V. Soldatova and I. A. Shekhanova.
Some results of mass marking of "non-standard" sturgeon fingerlings by means of radioactive phosphorus. 3833
Kennedy, Michael and Ann Healy.
Trout in Lough Glore Co., Westmeath, Ireland. 3868
Kilarski, Wincenty.
The development of the blood vessels in the folds of the intestine of the sea trout (Salmo trutta L.) 3911
Kimsey, J. B. and Leonard O. Fish.
Keys to the freshwater and anadromous fishes of California. 3835
Kinnear, J. E.
The minimum dosage of thiourea effectively inhibiting thyroxine synthesis in the flounder (Platichthys stellatus). 3870
Klick, Thomas and Clifford L. Brynildson.
Fall stocking has a place. 3991
Kodama, Yasuo, Yoshio Hiyama, Yukio Nose, Makoto Shimizu, Junko Matsubara, Koshi Onodera, and Norio Suzuki.
Predation of rainbow trout fry traced by radioisotope. 3852
Koga, Sigeyuki.
Studies on the fluctuation in catch of the tuna-fishing fleet---III. On the stomach contents of tuna in the western south Pacific Ocean, especially in the Fiji area. 3904
Koga, Sigeyuki.
Studies on the fluctuation in catch of the tuna-fishing fleet---II. On the latitudinal change of the hooked-rate of the albacore and the striped marlin in the Fiji area. 3905
Koops, Harald.
Die Bedeutung der staustufe geesthacht fur die quappenfischerei der Elbe. 3883
Krau, Luiza, Lejeune P. H. de Oliveira, Rubem do Nascimento, and Arnaldo Miranda.
Hydrobiological observation on fish mortality in the lagoon of Camorim. (Observacoes hidrobiologicas sobre a mortalidade de peixes na lagoa de Camorim.) 3928

Landgrebe, H.

Supervision of the impermeability of heating oil storage tanks. 4011

Lawler, G. H.
A mutant pike, Esox lucius. 3976

Lellak, Jan.
The bottom fauna of two ponds and their temporary periodicity. (Osidieni a sezonni dynamika zvireny dna dvou rybniku.) 3930

Lennon, Robert E. and Phillip S. Parker.
The stoneroller, Compostoma anomalum (Rafinesque), in Great Smoky Mountains National Park. 3964

Lewis, John M., Donald F. Hansen, George W. Bennett, and Robert J. Webb.
Hook-and-line catch in fertilized and unfertilized ponds. 3831

Lewis, William M. and R. M. Tarrant, Jr.
Sodium cyanide in fish management and culture. 3886

Livingston, D. L., Arthur M. Phillips, Jr. and R. F. Dumas.
The effect of starvation and feeding on the chemical composition of brook trout. 3892

Lucas, K. C.
The Robertson Creek spawning channel. 4001

Lund, William A., Dwight A. Webster, Richard W. Wahl, and William D. Youngs.
Observed and calculated lengths of lake trout (Salvelinus namaycush) in Cayuga Lake, New York. 3966

Lynn, Walter R. and Won Tak Yang.
The ecological effects of sewage in Biscayne Bay. Oxygen demand and organic carbon determinations. 4006

McAllister, D. E.
A simple clamp to aid in counting fin rays. 3861
G. wheatlandi, new species of fish for the province of Quebec. (Le Gasterosteus wheatlandi, nouvelle espece de poiss on pour la province de Quebec.) 3956

McCoy, Clarence J., Jr., Branley A. Branson and Morgan E. Sisk.
Notes on the freshwater fishes of Sonora with an addition to the known fauna. 3864

McDonald, J.
The behaviour of Pacific salmon fry during their downstream migration to freshwater and saltwater nursery areas. 3977

McFarland, William N.
The use of anesthetics for the handling and the transport of fishes. 3836
A study of the effects of anesthetics on the behavior and physiology of fishes. 3847

MacKinnon, D.
A successful transplant of salmon eggs in the Robertson Creek spawning channel. 4002

Madden, Kenneth, Kenneth D. Carlander, Richard R. Whitney, and Everett B. Speaker.
Evaluation of walleye fry stocking in Clear Lake, Iowa, by alternate-year planting. 3962

Margolis, L.
A new nematode of the genus Cucullanus (Camallanata: cucullanidae) from a flounder, Parophrys vetulus Girard, 1854, with notes on the species from pleuronectiformes. 3872

Marsden, K.
Determination of traces of cyanide in fish tissue. 4017

Matsubara, Junko, Yoshio Hiyama, Yukio Nose, Makoto Shimizu, Koshi Onodera, Yasuo Kodama, and Norio Suzuki.
Predation of rainbow trout fry traced by radioisotope. 3852

Mechanik, F. J.
The effect of oxygen concentration in water on the growth and nitrogen exchange of rainbow trout fry. 4022

Mendelson, Joan R. and Donn Eric Rosen.
The sensory canals of the head in poeciliid fishes (Cyprinodontiformes), with reference to dentitional types. 3865

Meyer-Waarden, P. F. and E. Halsband.
Entwicklung eines elektrobiologischen testes zur bestimmung der abwasserlast von flussen. 3906

Meyer-Waarden, P. F., E. Halsband and Inge Halsband.
Bibliographie uber die elektrofischerei und Ihre Grundlagen. 3901

Mikami, Takehiko and Kazuhiro Mizue.
Studies on the maturation and the seasonal cycle in the gonad of Girella punctata. 3903

Miller, Robert Rush and Carl L Hubbs.
The spiny-rayed cyprinid fishes (Plagopterini) of the Colorado River system. 3939

Miranda, Arnaldo, Lejeune P. H. de Oliveira, Rubem do Nascimento and Luiza Krau.
Hydrobiological observation on fish mortality in the lagoon of Camorim. (Observacoes hidrobiologicas sobre a mortalidade de peixes na lagoa de Camorim.) 3928

Misra, Biswanath, D. N. Ganguly and Nikhilesh Bhattacharya.
On the Interrelationships between total length, standard length, depth and weight of Lates Calcarifer. 3925

Mizue, Kazuhiro and Takehiko Mikami.
Studies on the maturation and the seasonal cycle in the gonad of Girella punctata. 3903

Moen, Tom.
Bullheads by the millions 3921

Molnar, Gyula.
Methode der blutentnahme fur haematologische untersuchungen bei fischen. 3894

Moody, Harold L.
Recaptures of adult largemouth bass from the St. Johns River, Florida. 3969

Mordstrom, Phyllis R., John A. Ross, Jack E. Bailey, and John R. Heaton.
A bacterial disease of yellow perch (Perca flavescens). 3972

Moreland, J.
The occurrence of the Pacific blue marlin (Makaira ampla mazara) in New Zealand waters. 3940

Morita, Tomokazu.
Fishing-ground constitutional studies on the white marlin, Marlina marlina Jordan and Hill, over the east China Sea. --I. On the fishing-ground constitu-

tion occurring with the seasonal change of the environment. 3851
Moulton, James M.
Swimming sounds and the schooling of fishes. 3874
Muller, W.
Beitrage zur biologie der quatte (Lota lota L.) nach untersuchungen in den gewassern Zwischen Elbe und Oder. 3896
Murray, R. W.
The response of the ampullae of Lorenzini of Elasmobranchs to mechanical stimulation. 3818

Nagata, Shun-ichi.
Some results of the tagging experiments of yellowtails in the Japan Sea. 3843
Neil, J. H.
Toxicity of cyanides to fish. 4025
Nelson, J. S., R. N. Gordon and R. A. Crouter.
The fish facilities at the Whitehorse Rapids power development, Yukon Territory. 4004
Neururer, Hans and Kurt Slanina.
Chemical control of undesirable pond plants with special attention to the toxicity of herbicides to fish. (Chemische berucksichtigung unerwunschter teichpflanzen mit besonderer berucksichtigung der fischtoxizitat von herbiziden.) 3957
Nicholls, C. F. and E. A. Doxtator.
An aquarium for maintaining constant prey population densities in studies of predator-prey interactions. 3979
Noble, Elmer R.
Fishes and their parasite-mix as objects for ecological studies. 3819
Norris, Kenneth S., Frank Brocato and Frank Calandrino.
A survey of fish transportation methods and equipment. 3854
Northcote, T. G.
Relationship between number of pyloric caeca and length of juvenile rainbow trout. 3860
Nose, Yukio, Yoshio Hiyama, Makoto Shimizu, Junko Matsubara, Koshi Onodera, Yasuo Kodama and Norio Suzuki.
Predation of rainbow trout fry traced by radioisotope. 3852

Oliva, Ota.
On the sea lamprey (Petromyzon marinus L.) from the Elbe River near Decin. (O nalezu mihule morski (Petromyzon marinus L.) v labi u decina.) 3951
Oliver, D. R.
The macroscopic bottom fauna of Lac La Ronge Saskatchewan. 3974
Onodera, Koshi, Yoshio Hiyama, Yukio Nose, Makoto Shimizu, Junko Matsubara, Yasuo Kodama, and Norio Suzuki.
Predation of rainbow trout fry traced by radioisotope. 3852
Orange, Craig J. and Gordon C. Broadhead.
Species and size relationship within schools of yellowfin and skipjack tuna, as indicated by catches in the eastern tropical Pacific Ocean. 3828
O'Rourke, F. J.
Serological criteria of species. 3941
Owens, M. and R. W. Edwards.
The effects of plants on river conditions. I. Summer crops and estimates of net productivity of macrophytes in a chalk stream. 4018

Parker, Phillip S. and Robert E. Lennon.
The stoneroller, Campostoma anomalum (Rafinesque), in Great Smoky Mountains National Park. 3964
Parr, Albert E.
Negative growth during metamorphosis and the regression of taxonomic variates upon size in fishes. 3907
Parry, Gwyneth.
The development of salinity tolerance in the salmon, Salmo salar (L.) and some related species. 3817
Paschalski, J.
Observations of environmental conditions of small ponds in the vicinity of Warsaw. (Obser-- wacje warunkow srodowiskowych drobnych zbiornikow wodnych okolic Warszawy.) 3934
Paterson, R. A.
Infestation of chytridiaceous fungi on phytoplankton in relation to certain environmental factors. 3822
Paulin, Francis L.
Snow removal heads off winterkill. 3989
Pearson, Oliver P.
A mechanical model for the study of population dynamics. 3821
Phillips, Arthur M., Jr., D. L. Livingston and R. F. Dumas.
The effect of starvation and feeding on the chemical composition of brook trout. 3892
Phillips, Ronald C.
Ecology and distribution of marine algae found in Tampa Bay, Boca Ciega Bay and at Tarpon Springs, Florida. 3881
Pisarenkova, A. S. and F. M. Sukhoverkhov.
The acclimatization of asiatic fish in Europe. (K probleme akklimatizatsii ryb v Evrope.) 3952
Prakash, A. and James R. Adams.
A histopathological study of the intestinal lesions induced by Echinorhynchus lageniformis (Acanthocephala--Echinorhynchidae in the starry flounder. 3869
Priestley, R. and R. E. Craig.
Photographic studies on fish populations. 3828
Pritchard, A. L.
Pollution and the fisheries. 4013
Prokesova, Vera.
Hydrobiological research of two naturally polluted pools in the wood inundation area of the Elbe. (Hydrogiologicky vyzkum dvou prirozene znecistenych tuni v zalesnene inundacni oblasti Labe). 3898
Pyefinch, K. A.
Trout in Scotland. A story of brown trout research at Pitlochry. 4026
Pyle, E., S. F. Snieszko, Ken Wolf, and C. E. Dunbar.

The virus nature of infectious pancreatic necrosis in trout. 3955

Radziej, J. and S. Bernatowicz.
Quantitative studies on the vascular flora of Lake Dobskie. (Badania Ilosciowe Flory Naczyniowej Jeziora Dobskiego.) 3885

Ragotzkie, Robert A.
Plankton productivity in estuarine waters of Georgia. 3846

Ragotzkie, Robert A. and Reid A. Bryson.
On internal waves in lakes. 3824

Rasmussen, Delbert H.
Preventing a winterkill by use of a compressed-air system. 3889

Reid, D. F., S. J. Townsley and W. T. Ego.
Uptake of radio-isotopes and their transfer through food chains by marine organisms. 4015

Renfro, William C.
Salinity relations on some fishes in the Aransas River, Texas. 3980

Richardson, I. D., D. H. Cushing, F. R. Harden Jones, R. J. H. Beverton, and R. W. Blacker.
Echo sounding experiments in the Barents Sea. 3840

Riffenburgh, Robert H.
A new method for estimating parameters for the Gompertz growth curve. 3876

Riffenburgh, Robert H. and Vernon E. Brock.
Fish schooling: a possible factor in reducing predation. 3879

Rinck, Emile and Jean Brouardel.
Appartus employed in the Mediterranean for the study of the production of organic material. (Appareillage employe en Mediterranee pour l'etude de la production de matiere organique.) 3958

Ronald, Keith.
The metazoan parasites of the heterosomata of the Gulf of St. Lawrence. 3871

Rosen, Donn Eric and Joan R. Mendelson.
The sensory canals of the head in poeciliid fishes (cyprinodontiformes), with reference to dentitional types. 3865

Ross, A. John, Phyllis R. Mordstrom, Jack E. Bailey, and John R. Heaton.
A bacterial disease of yellow perch (Perca flavescens). 3972

Rothschild, Brian J. and Earl E. Deubler, Jr.
Paralichthys squamilentus Jordan and Gilbert from North Carolina. 3858

Sanger, Gerald A. and George H. Allen.
Fecundity of rainbow trout from actual count of eggs. 3859

Sato, Ryuhei.
The use of probability paper for the graphical analysis of percentage composition of chum salmon with different scale characteristics. 3910

Scheier, A. and J. Cairns.
The effects of temperature and hardness of water upon the toxicity of potassium dichromate to the common bluegill sunfish. 4012

Schiemenz, F.
Unterschied der wanderungen der Fische, insbesondere der aale verschi edenen reifegrades, im unkanalisierten strom und im kamalisierten strom und die bedeutung der fischtreppen. 3899

Schlichting, Harold E., Jr.
The role of waterfowl in the dispersal of algae. 3916

Schneebeli, Walter, Earl S. Herald, Norval Green, and Kenneth Innes.
Catch records for seventeen shark derbies held at Elkhorn Slough, Monterey Bay, California. 3853

Schumann, George O.
An electrophoretic survey of multiple haemoglobins in some fresh-water fishes. 3945

Schwartz, F. J.
Records of the Allegheny brook lamprey Ichthyomyzon greeleye Hubbs and Trautman, from West Virginia, with comments on its occurrence with Lampetra aeptypera (Abbott). 3942

Schweng.
Pollution of streams and fisheries. 4019

Scrimger, J. A.
Temperature variations in Esquimalt Lagoon--a small landlocked body of water subject to tidal flushing. 3823

Shekhanova, I. A., G. S. Karzinkin and E. V. Soldatova.
Some results of mass marking of "non-standard" sturgeon fingerlings by means of radioactive phosphorus. 3833

Shetter, David S.
The relative effectiveness of salmon eggs and earthworms as bait for trout in the Sturgeon River, Michigan. 3967

Shiffman, R. H.
The uptake of strontium from diet and water by rainbow trout. 4024

Shimizu, Makoto, Yoshio Hiyama, Yukio Nose, Junko Matsubara, Koshi Onodera, Yasuo Kodama, and Norio Suzuki.
Predation of rainbow trout fry traced by radio-isotope. 3852

Shimomura, Toshimasa.
Effects of the typhoon "Ruth" (1951) upon the sea conditions and fishing. 3844

Simmons, Ernest G. and H. Dickson Hoese.
Studies on the hydrography and fish migration of Cedar Bayou, a natural tidal inlet on the central Texas coast. 3849

Simpson, A. C.
The spawning of the plaice (Pleuronectes platessa) in the Irish Sea. 3841

Sisk, Morgan E., Branley A. Branson and Clarence J. McCoy, Jr.
Notes on the freshwater fishes of Sonora with an addition to the known fauna. 3864

Skud, Bernard E. and William B. Wilson.
Role of estuarine waters in Gulf fisheries. 3996

Slanina, Kurt and Hans Neururer.
Chemical control of undesirable pond plants with special attention to the toxicity of herbicides to fish. (Chemische berucksichtigung unerwunschter teichpflanzen mit besonderer berucksichtigung der fischtoxizitat von herbiziden. 3957

Smith, M. W.

An attempt to improve trout fishing in a New Brunswick lake by deferment of opening of angling season. 3978

Snieszko, S. F., Ken Wolf, C. E. Dunbar, and E. Pyle.
The virus nature of infectious pancreatic necrosis in trout. 3955

Snow, Howard.
Bluegill at Murphy Flowage. 3984

Sogandares-Bernal, Franklin and John F. Bridgman.
Three ascocotyle complex trematodes (Heterophyidae) encysted in fishes from Louisiana, including the description of a new genus. 3981

Sokolov, V. A.
The mechanism for buoyancy variation in fishes. 3943

Soldatova, E. V., G. S. Karzinkin and I. A. Shekhanova.
Some results of mass marking of "non-standard" sturgeon fingerlings by means of radioactive phosphorus. 3833

Sorokin, Yu. I.
Role of chemosynthesis in the production of organic matter in reservoirs. IV. Feeding aquatic invertebrates on methane and hydrogen-oxidizing autorophic bacteria. 3935

Sparks, Albert K. and Gilbert V. Chambers.
An ecological survey of the Houston ship channel and adjacent bays. 3845

Speaker, Everett B., Kenneth D. Carlander, Richard R. Whitney, and Kenneth Madden.
Evaluation of walleye fry stocking in Clear Lake, Iowa by alternate-year planting. 3962

Speare, Edward P.
Growth of the central Johnny darter, Etheostoma nigrum nigrum (Rafinesque) in Augusta Creek, Michigan. 3863

Springer, Victor G.
Ichthyological surveys of the lower St. Lucie and Indian Rivers, Florida East Coast. 3902

Sramek-Husek, Rudolf.
The autumn plankton of several Czechoslovakian dams. (Podzimni Plankton nekolika Ceskoslovenskych prehrad.) 3936

Srivastava, P. N.
Influence of thyroid on radiophosphorus metabolism in fish. 3829

Stein, M., E. C. Tsivoglou and W. W. Towne.
Control of radioactive pollution of the Animas River. 3937

Stewart, L.
An investigation into the effects of electric fishing equipment of salmon and sea trout within the area of the Lancashire River Board. 3961

Straty, Richard R.
Methods of enumerating salmon in Alaska. 3995

Stundl, K.
Water problems in polluted impounding reservoirs. 4016

Sugiura, Kenzo and Toshiyuki Hirano.
On the salinity distribution in a small bay with river discharge. 3929

Sukhoverkhov, F. M. and A. S. Pisarenkova.
The acclimatization of asiatic fish in Europe. (K probleme akklimatizatsii ryb v Evrope). 3952

Sundararaj, Bangalore I.
Age and growth of the spot, Leiostomus xanthurus Lacepede. 3982

Suzuki, Norio, Yoshio Hiyama, Yukio Nose, Makoto Shimizu, Junko Matsubara, Koshi Onodera and Yasuo Kodama.
Predation of rainbow trout fry traced by radioisotope. 3852

Swift, D. R.
An improved feed for experimental fish. 3855

Tanner, W. F.
Expanding shoals in areas of wave refraction. 3856

Tarrant, R. M., Jr. and William M. Lewis.
Sodium cyanide in fish management and culture. 3886

Tarzwell, C. M.
Water quality criteria for aquatic life. 4020

Thoits, Charles F., III, D. Homer Buck and Maurice A. Whitacre.
Some experiments in the baiting of carp. 4005

Tiemeier, Otto W. and J. B. Elder.
Growth of stunted channel catfish. 3887

Tiews, Klaus.
Bestimmung des altersaufbaunes des roten thunes (Thunnus thynnus (Linnaeus)) in der Nordsee mit hilfe des allometrischen wachstums der augenhohle. 3838

Towne, W. W., E. C. Tsivoglou and M. Stein.
Control of radioactive pollution of the Animas River. 3937

Townsley, S. J., D. F. Reid and W. T. Ego.
Uptake of radio-isotopes and their transfer through food chains by marine organisms. 4015

Tranter, D. J.
A method for determining zooplankton volumes. 3877

Triplett, Edward L.
Notes on the life history of the barred surfperch, Amphisticus argenteus Agassiz and a technique for culturing embiotocid embryos. 3999

Tsivoglou, E. C., M. Stein and W. W. Towne.
Control of radioactive pollution of the Animas River. 3937

Tugendhat, B.
The normal feeding behaviour of the three-spined stickleback (Gasterosteus aculeatus L.) 3927

Velz, C. J. and J. J. Gannon.
Forecasting Heat Loss in Ponds and Streams. 3917

Verduin, Jacob.
Phytoplankton communities of western Lake Erie and the CO_2 and O_2 changes associated with them. 3825

Wagner, John L. and W. L. Hartman.
An underwater camera case. 3888

Wahl, Richard W., Dwight A. Webster, William A. Lund, and William D. Youngs.
Observed and calculated lengths of lake trout (Salvelinus namaycush in Cayuga Lake, New York.) 3966

Walburg, Charles H.
Abundance of St. Johns River shad. 3997
Wald, George.
The significance of vertebrate metamorphosis. 3948
Walton, G., S. L. Chang, R. L. Woodward, and B. B. Berger.
Effect of disinfecting agents on evaporation reduction with hexadecanol. 4010
Waters, Thomas F.
The development of population estimate procedures in small trout lakes. 3968
Webb, Robert J., Donald F. Hansen, George W. Bennett, and John M. Lewis.
Hook-and-line catch in fertilized and unfertilized ponds. 3831
Webster, Dwight A., William A. Lund, Richard W. Wahl, and William D. Youngs.
Observed and calculated lengths of lake trout (Salvelinus namaycush) in Cayuga Lake, New York. 3966
Weisel, George F.
The osteocranium of the catostomid fish, Catostomus macrocheilus. A study in adaptation and natural relationship. 3912
Westlake, D. F.
The effects of organisms on pollution. 3953
Whitacre, Maurice A., D. Homer Buck and Charles F. Thoits, III.
Some experiments in the baiting of carp. 4005
Whitney, Richard R., Kenneth Madden, Kenneth D. Carlander, and Everett B. Speaker.
Evaluation of walleye fry stocking in Clear Lake, Iowa by alternate-year planting. 3962
Wiborg, K. F.
Investigations on eggs and larvae of Commercial fishes in Norwegian coastal waters and offshore waters in 1957-58. 3922
Investigations on pelagic fry of cod and haddock in coastal and offshore areas of northern Norway in July-August 1957. 3923
Wilson, William B. and Bernard E. Skud.
Role of estuarine waters in Gulf fisheries. 3996
Witt, Arthur Jr.
Length and weight of ancient freshwater drum, Aplodinotus grunniens, calculated from otoliths found in Indian middens. 3866
Wolf, Ken, S. F. Snieszko, C. E. Dunbar, and E. Pyle.
The virus nature of infectious pancreatic necrosis in trout. 3955
Wood, E. M., W. T. Yasutake, J. E. Halver, and A. N. Woodall.
Chemical and histological studies of wild and hatchery salmon in freshwater. 3970
Woodall, A. N. E. M Wood, W. T. Yasutake, and J. E. Halver.
Chemical and histological studies of wild and hatchery salmon in freshwater. 3970
Woodward, R. L., S. L. Chang, G. Walton, and B. B. Berger.
Effect of disinfecting agents on evaporation reduction with hexadecanol. 4010
Wright, John C.
The limnology of Canyon Ferry Reservoir: III. Some observations on the density dependence of phytosynthesis and its cause. 3826

Yang, Won Tak and Walter R. Lynn.
The ecological effects of sewage in Biscayne Bay. Oxygen demand and organic carbon determinations. 4006
Yasutake, W. T., E. M. Wood, J. E. Halver, and A. N. Woodall.
Chemical and histological studies of wild and hatchery salmon in fresh water. 3970
Yeh, Ye-Tsu.
A preliminary report on the oxygen consumption, energy requirement, asphyxiation point and respiratory quotient of the fish fry and young fish. 3949
Youngs, William D., Dwight A. Webster, William A. Lund, and Richard W. Wahl.
Observed and calculated lengths of lake trout (Salvelinus namaycush) in Cayuga Lake, New York. 3966

Zarnecki, St.
Recent changes in the spawning habits of sea trout in the upper Vistula. 3880

++++++++++++++++++++++++

SUBJECT INDEX

Age and growth,
  burbot, 3896
  catfish, channel, 3887
  curves,
    Gompertz, 3876
    survival estimates, 3878
  darter, Johnny, 3863
  drum, freshwater, 3866
  fishes, year 1759, 3920
  flounder, southern, 3875
  Lates calcarifer, 3925
  negative, fishes, 3907
  Perca fluviatilis, 3895
  spot, 3982
  trout,
    brown, 3842, 3897, 3963
    lake, 3966, 3971
    rainbow, 4022
Albacore, harvest, 3905
Algae, waterfowl dispersal, 3916
Alosa sapidissima (see shad, American)
Amphisticus argenteus (see surfperch, barred)
Anatomy,
  ampullae of Lorenzini elasmobranchs, 3918
  blood,
    fishes, 3941
    vessels, brown trout, 3911
  eye, bluefin tuna, 3838
  fat, marine fish, 3914
  fins,
    caudal, rainbow trout, 3862
    dorsal, fish, 3954
    pelvic, rainbow trout, 3862
    rays, fishes, 3861
  gills,
    Anguilla anguilla, 3924
    Lucioperca lucioperca, 3924
    Misgurnis fossilis, 3924
  intestines,
    Gadiformes, 3882
    Macruriformes, 3882
  morphometry, mountain whitefish, 3816
  osteocranium, largescale sucker, 3912
  otolith, fish, 3839
  pyloric caeca, rainbow trout, 3860
  scales, chum salmon, 3910
  sensory canals, Poeciliidae, 3865
  swimbladder,
    fish, 3943
    marine fish, 3914
Anguilla anguilla, gills, 3924
Aplodinotus grunniens (see drum, freshwater)

Bass, largemouth,
  harvest, 3831
  metabolism, 3890
  migration and movement, 3969
Behavior, symposium, fish, 3814
Benthos,
  lake, macroscopic, 3974
  ponds, 3930
  sampling, 3933
Bibliography, electrofishing, 3901
Biocides,
  herbicides,
    Dowpon, reeds, 4021
    various, fish toxicity, 3957
  insecticides,
    benzene hexachloride, coho salmon, 4003
    DDT, aquatic insects, 3960
    granular, 3950
    various, predaceous insects, 3832
  piscides,
    rotenone,
      baiting carp, 4005
      fish food organisms, 3918
    sodium cyanide, fish, 3886
Bluegill,
  harvest, 3831
  reactions, acid, 3850
  regulations, 3984
  toxicity, potassium dicromate, 4012
Bullhead, harvest, 3921
Burbot,
  life history, 3896
  migration, 3883

Campostoma anamalum (see stoneroller)
Carassius auratus (see goldfish)
Carp,
  baiting, 4005
  introduction, 3988
Catfish, channel, growth, 3887
Catostomus macrocheilus (see sucker, largescale)
Chemical factors,
  carbon,
    dioxide, phytoplankton, 3825
    organic, bay, 4006
  molybdenum, primary production, 3857
  oxygen,
    demand, bay, 4006
    organisms, 3953
    phytoplankton, 3825
    summer kill, 4023
    trout growth, 4022
    winter kill, 3889, 3989
  salinity,
    bay, 3929
    estuary, 3996
    fishes, 3980
    growth and survival, flounder, 3875
  various,
    pollution, 3898, 3928
    ponds, 3934
Cichlidae, life history, 3938
Cod, Atlantic, fry, 3923
Competition, stoneroller-rainbow trout, 3964
Coregonus clupeaformis (see whitefish, lake)
Cyprinidae, spiny rayed, 3937
Cyprinus carpio (see carp)

Darter, Johnny, growth, 3863
Diet,
  fish, improved, 3855

Diet, cont.
trout,
brook, chemical changes, 3892
rainbow, strontium uptake, 4024
Diseases,
bacterial, yellow perch, 3972
infectious pancreatic necrosis, trout, 3955
Distribution,
albacore, 3905
algae, Florida, 3881
Cyprinids, Colorado River, 3939
fishes,
circumtropical, 3867
freshwater, Sonora, 3864
flounder, broad, 3858
lamprey,
Allegheny brook, 3942
sea, 3951
Makaira ampla mazara, 3940
marlin, striped, 3905
stickleback, twospine, 3956
trout, cutthroat, 400
Drugs, various, anesthetics, 3836, 3847
Drum, freshwater, length and weight, 3866

Ecology,
fishes-parasites, 3819
habitat, 3820
Houston ship channel, 3845
underwater camera, 3881
Economics,
recreation, streams
whitefish, lake, fishery, 3975
Elasmobranchs, ampullae of Lorenzini, 3818
Electricity,
fishing,
bibliography, 3901
salmon and sea trout, 3961
pollution, test, 3906
Embryology,
pumpkinseed, 3900
trout, brown, 3911, 3947
Equipment,
aerator, 3889, 4023
aquarium, predator-prey, 3979
camera,
case, underwater, 3888
flash, fish populations, 3827
clamp, fin rays, 3861
echo sounder, fish location, 3840
electrical, pollution test, 3906
nets, sampling salmon, 3995
oil tanks, pollution, 4011
samplers,
carbon^{14} method, 3958
water, 4009
spin dryer, aquatic vegetation, 4018
transportation, fish, 3854
Esox
lucius (see pike, northern)
masquinongy (see muskellunge)
Etheostoma nigrum (see darter Johnny)
Euthynnus pelamis (see tuna, skipjack)

Fertilization, ponds, harvest, 3831
Flounder,
broad, distribution, 3858
southern, postlarvae, 3875
starry,
parasite, 3869
thyroxine synthesis, 3870
Food habits,
aquatic invertibrates, 3935
cod, Atlantic, 3923
haddock, 3923
stickleback, threespine, 3927
tuna,
bigeye, 3904
yellowfin, 3904
Fundulus
grandis (see killifish, gulf)
similis (see killifish, longnose)

Gadiformes, intestines, 3882
Gadus morhua (see cod, Atlantic)
Gambusia, mate preference, 4007
Gasterosteus
aculeatus (see stickleback, threespine)
wheatlandi (see stickleback, twospine)
Genetics,
hybrids,
cyprinodonts, 2848
Gambusia, 4007
mutant, northern pike, 3976
Girella punctata, maturation, 3903
Goldfish, reactions, acids, 3850

Habitat development, spawning channel, salmon, 4001, 4002
Haddock, fry, 3923
Haplochromis, taxonomy, 3837
Harvest,
bass, largemouth, 3831
bluegill, 3831
bullheads, 3921
commercial, questionaire, 3891
fish,
echo sounding, 3840
typhoon effects, 3844
shark derbies, 3853
sport, Indian lands, 3965
trout, bait, 3967
tuna,
skipjack, 3830
yellowfin, 3830
whitefish, lake, 3975
yellowtail, 3919
Heterosomata, parasites, 3871

Ichthyomyzon greeleyi (see lamprey, Allegheny brook)
Ictalurus punctatus (see catfish, channel)
Identification,
fish, California, 3835
lamprey, Allegheny brook, 3942
Mysidacea, 3873
Isospondyli, taxonomy, 3913

Killifish,

Killifish, cont.
gulf, hybrid survival, 3848
longnose, hybrid survival, 3848

Lampetra aepyptera (see lamprey, least brook)
Lamprey,
Allegheny brook, distribution, 3942
least brook, distribution, 3942
sea, distribution, 3951
Lates calcarifer, length, depth, weight, 3925
Leiostomus xanthurus (see spot)
Lepomis
gibbosus (see pumpkinseed)
macrochirus (see bluegill)
Life history,
Cichlids, 3938
surfperch, barred, 3999
trout, Ireland, 3868
Limnology, St. Lucie and Indian Rivers, Florida, 3902
Lota lota (see burbot)
Lucioperca lucioperca, gills, 3924

Macruriformes, intestine, 3882
Makaira
ampla mazara, distribution, 3940
audax (see marlin, striped)
Management, fish and wildlife, watersheds, 3993
Marlin, striped, harvest, 3905
Marlina marlina, fishing grounds, 3851
Melanogrammus aeglefinus (see haddock)
Micropterus salmoides (see bass, largemouth)
Migration and movements,
bass, largemouth, 3969
burbot, 3883
fish,
cedar Bayou, Texas, 3849
water level fluctuations, 3899
intraspecific impulse, 3834
Marlina marlina, 3851
salmon,
Pacific, fry, 3977
power dam, 4004
schooling,
predation, 3879
swimming sounds, 3874
tuna,
skipjack, 3828
yellowfin, 3828
Misgurnus fossilis, gills, 3924
Muskellunge, stocking returns, 3983
Mysidacea, identification, 3873

Oncorhynchus
gorbuscha (see salmon, pink)
keta (see salmon, chum)
kisutch (see salmon, coho)
tschawytscha (see salmon, chinook)

Paralichthys
lethostigma (see flounder, southern)
squamilentus (see flounder, broad)
Parasites,
Chytridiaceous fungi, phytoplankton, 3822
Parasites, cont.
Cucullanus, English sole, 3872
Echinorhynchus lageniformus, starry flounder, 3869
ecology, 3819
Metazoan, Heterosomata, 3871
Trematodes, fishes, 3981
Parophrys vetulus (see sole, English)
Perca
flavescens (see perch, yellow)
fluviatilis, age and growth, 3895
Perch, yellow, bacterial disease, 3972
Petromyzon marinus (see lamprey, sea)
Physical factors,
evaporation, reservoirs, Hexadecanol, 4010
shoals, sea, wave refraction, 3856
snow, lakes, removal, 3989
temperature,
bass, largemouth, 3890
lagoon, tides, 3823
lakes,
littoral zone, 3884
waves, 3824
ponds,
heat loss, 3917
stratification, 3934
reservoirs, pollution. 3898
typhoon, sea, Japan, 3844
various, estuaries, 3996
Physiology,
blood, fish, 3893, 3894, 3945
changes, fish, electricity, 3906
chemical, brook trout, 3892
digestion, fish, enzymes, 3946
metabolism, largemouth bass, 3890
metamorphosis, vertebrates, 3948
mineral, fish, thyroid, 3829
photosynthesis, reservoirs, 3826
radioactive,
fish, measurement, 3944
tuna, potassium, 3973
respiration, fish, fry, 3949
thyroid, starry flounder, 3870
various,
fishes, chemicals, 3847
salmon, freshwater, 3970
Pike, northern, mutant, 3976
Plankton,
autumn, reservoirs, 3936
fish food, rotenone, 3918
phyto-,
communities, 3825
ecology and distribution, 3881
parasite, 3822
photosynthesis, 3826
predators, reservoirs, 3935
primary production, estuary, 3846
zoo-,
reservoir, 3931
volumes, determination, 3877
Platichthys stellatus (see flounder, starry)
Pleuronectes platessa,
fecundity, 3908, 3909
spawning, 3841

Poeciliidae, sensory canals, 3865
Pollution,
acids, fishes, 3850
cyanide, fish, 4017, 4025
D.D.T., aquatic insects, 3960
graphic expression, 3932
oil, storage tanks, 4011
organic, reservoirs, 3898
potassium dichromate, bluegill, 4012
radioactive, river, 3937
sewage, ecological effects, 4006
test, electrical - biological, 3906
various,
fish, populations, 3992
fisheries, 4013
organism effects, 3953
reservoirs, 4016
Salmonidae, 3815
stream life, 4014
streams and fisheries, 4019
symposium, 3959
water quality criteria, 3915, 4020
Populations,
dyanamics, mechanical model, 3821
fish,
photography, 3827
polluted waters, 3992
salmon,
chum, probability paper, 3910
estimates, 3995
shad, American, river, 3997
trout, estimates, 3968
Predation,
-prey aquarium, 3979
rainbow trout fry-trout and birds, 3852
reduction, schooling, 3879
Production, primary,
chalk stream, 4018
estuary, 3846
limiting factor, molybdenum, 3857
Prosopium williamsoni (see whitefish, mountain)
Pumpkinseed, spawning, 3900

Radioactivity,
carbon ^{14},
limiting factor, molybdenum, 3857
Steelman, organic material, 3958
Fe^{59}, measurement, fish, 3944
isotopes,
predation, tracing, 3852
uptake, food chains, 4015
natural, tuna, 3973
phosphorus,
marking, sturgeon, 3833
metabolism, fish, 3829
strontium ^{90}, uptake, trout, 4024
Regulations,
bluegills, 3984
bullheads, 3921
trout,
brook, 3978, 3986
fly fishing, 3990
Rehabilitation, carp baiting, 4005
Reproduction,
burbot, 3896
cod, Atlantic, 3923
fishes, commercial, 3922
Gambusia, 4007
Girella punctata, 3903
haddock, 3923
Pleuronectes platessa, 3841, 3908, 3909
pumpkinseed, 3900
salmon,
Pacific, 4001
pink, 4002
stickleback, threespine, 3926
trout,
rainbow, 3859
sea, 3880
Research,
game fish, marine, 4008
salmon, Pacific, 3998
trout, brown, 4026

Salmo
clarki (see trout, cutthroat)
gairdneri (see trout, rainbow)
salar (see salmon, Atlantic)
trutta (see trout, brown)
Salmon,
Atlantic, tolerance, salinity, 3817
chinook, spawning channel, 4001
chum, circuli, populations, 3910
coho,
insecticides, 4003
physiology, 3970
spawning channel, 4001
fishing equipment, electric, 3961
Pacific,
enumeration, 3995
migration, 3977, 4004
research, 3998
pink,
spawning channel, 4001, 4002
pollutants, toxicity, 3815
Salvelinus
fontinalis (see trout, brook)
namaycush (see trout, lake)
Sampling,
benthos, 3933
fish, polluted waters, 3992
salmon, Pacific, 3995
Seriola quinquerdiata (see yellowtail)
Shad, American, abundance, 3997
Sole, English, parasite, 3872
Spot, age and growth, 3982
Stickleback,
threespine,
food habits, 3927
reproduction, 3926
twospine, distribution, 3956
Stizostedion vitreum (see walleye)
Stocking and introduction,
algae, waterfowl, 3916
asiatic fish, Europe, 3952
carp, 3988
fish,

Stocking and introduction, cont.
fish, cont.
anesthetics, 3836
transportation, 3854
muskellunge, returns, 3983
trout,
brook, 3978
fall, 3991
walleye, alternate year, 3962
Stoneroller, Great Smoky Mountains, 3964
Sturgeon, marking, 3833
Sucker, largescale, osteocranium, 3912
Surfperch, barred, life history, 3999
Survival,
fish, larvae, estimates, 3878
flounder, southern, salinity, 3875
salmonids, salinity tolerance, 3817
trout, lake, stocked, 3971

Tagging and marking,
sturgeon, radioactive phosphorus, 3833
yellowtail, 3843
Taxonomy,
Cyprinidae, spiny-rayed, 3939
fishes, hemoglobin, 3945
Haplochromis, 3837
Isospondylous fishes, 3913
Thunnus
alalunga (see albacore)
albacares (see tuna, yellowfin)
obesus (see tuna, bigeye)
thynnus (see tuna, bluefin)
Tilapia mossambica, radio-isotope uptake, 4015
Trout,
brook,
bait, effectiveness, 3967
chemical composition, diet, 3892
refuges, 3986
regulations, deferred opening, 3978
brown,
bait, effectiveness, 3967
blood vessels, intestines, 3911
growth, 3842, 3897, 3963
lymph heart, 3947
research, 4026
salinity tolerance, 3817
cutthroat, distribution, 4000
habitat, springs, 3987
infectious pancreatic necrosis, 3955
lake,
body-scale relationship, 3966
tagged, survival and growth, 3971
life history, 3868
populations, 3968
rainbow,
bait, effectiveness, 3967
diet, strontium uptake, 4024
fecundity, 3859
fins, anomalous, 3862

Trout, cont.
rainbow, cont.
growth and nitrogen exchange, 4022
predation, 3852
pyloric caeca, 3860
salinity tolerance, 3817
trout redds, destruction, 3964
regulations, fly fishing, 3990
sea,
electric fishing, 3961
spawning, 3880
stocking, fall, 3991
toxicity, pollutants, 3815
Tuna,
bigeye, food habits, 3904
bluefin, populations, 3838
radioactivity, natural, 3973
skipjack,
harvest, 3830
schooling, size and species, 3828
yellowfin,
food habits, 3904
harvest, 3830
schooling, size and species, 3828

Vegetation, aquatic,
control, 3957
primary production, 4018
quantitative studies, 3885

Walleye, stocking, evaluation, 3962
Water developments,
reservoirs,
aeration, artificial, 4023
discharge, bay, 3929
drawdowns, fish management, 3985
evaporation reduction, 4010
fish,
introduction, 3952
passage, 4004
limnology, 3826
Perca fluviatilis, 3895
plankton,
autumn, 3936
food habits, 3935
pollution, 3898, 4016
trout, brown, 3897
zooplankton, 3931
streams, recreation, 3994
various, fish movements, 3899
watersheds, fish and wildlife management, 3993
Whitefish,
lake, fishery, 3975
mountain, morphometry, 3816

Yellowtail,
harvest, 3919
tagging, 3843

****

ABSTRACTORS OTHER THAN AUTHORS AND STAFF:

G. R. Bernard
Biological Abstracts
K. D. Carlander
H. F. Copeland
R. P. Elliott
H. F. Freudenthal
Isaiah Gellman
G. N. Ludwig
Medican Documentation Service
C. E. Parker
A. Pigon
L. I. Scott
Water Pollution Abstracts
Frank Winder

****

INT.DUP.,D.C.61- 99167